US Army Corps
of Engineers
St. Paul District

D R A F T

GENERAL REEVALUATION REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

EAST GRAND FORKS, MINNESOTA
AND
GRAND FORKS, NORTH DAKOTA

Local Flood Reduction Project

RED RIVER OF THE NORTH

AUGUST 1998

TABLE OF CONTENTS

Continued - TABLE OF CONTENTS

(NOTE: See plate 2 for a drawings index listing and description of the plates)

TECHNICAL APPENDICES A – L

DETAILED TECHNICAL DOCUMENTATION IS BOUND SEPARATELY AS A SUPPLEMENTARY DOCUMENTATION REPORT (Volumes 1 and 2) AND IS AVAILABLE AS A REFERENCE. COPIES OF THE SUPPLEMENTARY REPORT/ APPENDICES ARE AVAILABLE AT CITY HALL, AT LOCAL LIBRARIES IN GRAND FORKS AND EAST GRAND FORKS, AND AT THE ST. PAUL DISTRICT CORPS OF ENGINEERS LIBRARY.

VOLUME 1 OF THE SUPPLEMENTARY REPORT INCLUDES:

Appendix A H&H Appendices
- Hydrologic
- Hydraulic
- Risk Based
- Interior Flood Control

Appendix B Geotechnical Appendices
- Geotechnical and Geology
- Reliability Assessment
- HTRW Evaluations

Appendix C Economics – Social – Financial Appendices

VOLUME 2 OF THE SUPPLEMENTARY REPORT INCLUDES:

Appendix D Cost Engineering Appendix

Appendix E Environmental Appendices

Appendix F Real Estate Supplement/Appendix

Appendix G Recreation and Aesthetics Plan Appendix

Appendix H Mechanical, Electrical, Architectural Appendix

Appendix I Structural Design Appendix

Appendix J Supplementary Report on Split-Flow Diversion

Appendix K Preliminary “Project Management Plan” Report

Appendix L Correspondence and Review Comments

Preface

After record-setting snow deposition across most of the Red River Valley, 1997 spring flooding on the Red River was the worst this region has experienced in modern history. At Grand Forks, North Dakota, and East Grand Forks, Minnesota, the river rose to a height of 54.3 feet – over 26 feet above its flood stage. The cities had begun preparing for the flood of 1997 well in advance. But on April 19, after weeks of advance protection measures and ongoing heroic floodfighting effort, the emergency levee systems were overtopped and the floodwaters came pouring into Grand Forks and East Grand Forks. During this devastating disaster, over 90% of the 52,500 residents of Grand Forks were evacuated and all of East Grand Forks' 9,000 residents were forced to leave their homes. Three-quarters of the homes in Grand Forks and 99% of the homes in East Grand Forks were damaged. The flood heavily damaged all the downtown businesses in both communities, and 11 commercial buildings in Grand Forks were totally destroyed by fire. In addition to the tremendous personal economic hardship that the flood caused, most of the citizens lost city services such as water, sewer, and power and were forced to live in temporary shelters and housing. The 1997 East Grand Forks/Grand Forks flood was one of the worst disasters ever experienced in North Dakota and Minnesota, and the effects of the flood were felt regionally and nationally. Estimates of the total flood related damages in the East Grand Forks/Grand Forks area range from 1 to 1.5 billion dollars.

Due to the urgency of the situation and the desire of all levels of Government to take action to prevent future catastrophic floods, a City of East Grand Forks request to reactivate an authorized flood protection plan for that city was approved by the Corps of Engineers. Because the Corps of Engineers recognized that neither city could be protected against large floods independently, flood protection for Grand Forks was added to the East Grand Forks project authority, and pre-engineering and design studies were reactivated in May 1997. This General Reevaluation Report (GRR) and associated Environmental Impact Statement (EIS) culminates and documents changed conditions, evaluates an array of possible remedial plans, and presents a National Economic Development (NED) plan. This report serves as a decision document, and the report findings will be used as a basis to request Congressional authorization for the project in the Water Resources Development Act of 1998.

Normally, the process of preparing and coordinating a decision document and EIS of this nature would take 48 months. However, in an effort to expedite permanent flood reduction for East Grand Forks and Grand Forks, this report is being given very high priority within all levels of the Corps of Engineers and at the Office of Management and Budget and is scheduled to be completed in approximately 18 months.

The objective of this study has been to define a feasible multi-purpose local flood reduction project on the Red and Red Lake Rivers at East Grand Forks, Minnesota, and Grand Forks, North Dakota, that would significantly reduce future flood damages. In addition to the primary flood reduction features of the project, secondary recreation features have been added at the request of the Local Sponsors. These recreation/greenway features are integrated into the project design and are described and separably justified in this report.

Executive Summary

East Grand Forks, Minnesota, and Grand Forks, North Dakota, are located on the Red River of the North approximately 298 miles above the mouth of the river at Lake Winnipeg, Manitoba, Canada. The East Grand Forks-Grand Forks metropolitan area has a population of approximately 60,000 and is located about 100 miles south of the U.S. /Canada border.

Both cities have a long history of significant flooding from the Red River of the North and the Red Lake River. The most damaging flood occurred in April 1997 when the temporary levee systems and heroic floodfighting efforts of both communities were not successful in holding back the floodwaters of the Red River. The resulting damages were disastrous and affected both cities dramatically. Total damages to existing structures and contents during the 1997 flood have been calculated to exceed $800 million. An additional $240 million was spent for emergency related costs.

The original authorization for this study was established in the Flood Control Acts approved 30 June 1948 (P.L. 80-858), and 17 May 1950 (P.L. 81-517). The Flood Control Act of 1970 (P.L. 91-611) allowed local interests additional time to furnish assurances of local cooperation. This study was accomplished by resuming Planning, Engineering, and Design (PED) authority for East Grand Forks and has been expanded to include the Grand Forks area. Congressional construction authorization will be sought in the Water Resources Development Act of 1998.

After identifying interagency and public concerns, identifying potential opportunities, and completing a comprehensive process of screening alternative plans, a single plan was selected for detailed design and evaluation. The design for that plan was then optimized, refined, costed, and evaluated from an economic and environmental perspective and is documented in this report. This plan, referred to as the National Economic Development (NED) plan, is a multi-purpose project that would provide reliable permanent flood protection for all areas of East Grand Forks and Grand Forks. The plan consists of a permanent levee and floodwall system designed to reliably contain a 210-year flood event (equates to an 86-percent reliability of containing the 0.47 percent exceedance frequency flood event and would reliably protect against a flood of the magnitude of the 1997 flood). The recommended NED plan includes recreational features, removal of an existing pedestrian bridge, and channel diversion features on English and Hartsville Coulees.

The recommended plan presented in this General Reevaluation Report would have a significant beneficial effect upon the local economy by allowing for future growth and improved public safety by providing improved flood reduction and removing protected areas from the regulatory floodplain. The plan also would improve recreational opportunities and would enhance the biological diversity in the open space created as a result of the project. The recommended plan anticipates the need to acquire over 250 single-family residential structures, 95 apartment or condominium units, and 16 businesses along the current levee/floodwall alignment. Some structures adversely affected by the proposed project are historically significant.

The fully funded cost of the recommended multipurpose project is $342,738,000, including recreation features and cultural resources mitigation costs. The Federal share of the project would be $171,917,500 and the non-Federal share would be $170,820,500. The cost-to-benefit ratio has been calculated as 1.12 for the basic flood reduction features of the project and as 2.18 for the separable recreation features. Therefore, both increments are economically feasible. The project recommended has an overall benefits-to-costs ratio of 1.16.

Further plan refinements will be conducted throughout the reevaluation phase. These refinements may alter project materials, design, cost, and cost apportionment and/or Federal participation in the project or any of its components.

The Cities of East Grand Forks, Minnesota, and Grand Forks North Dakota, will serve as the non-Federal sponsors for the project. The State of Minnesota has committed through State legislation to provide financial support in the form of bonds and returned sales taxes to the City of East Grand Forks. The State of North Dakota has committed in the form of verbal and written commitments from the Governor to provide financial assistance to the City of Grand Forks.

STUDY AUTHORITY

The original authorization for this study was established in the Flood Control Acts approved June 30, 1948 (Public Law 80-858), and May 17,1950 (Public Law 81-516). The Flood Control Act of 1970 (Public Law 91-611) allowed local interests additional time to furnish assurances of local cooperation. The pertinent paragraphs from these acts are given below:

a. Flood Control Act of 1948:

The comprehensive plan for flood control and other purposes in the Red River of the North drainage basin, North Dakota, South Dakota, and Minnesota as set forth in the report of the Chief of Engineers dated May 24, 1948, is approved and there is hereby authorized the sum of $2,000,000 for the partial accomplishment of that plan.

b. Flood Control Act of 1950:

In addition to previous authorizations, there is hereby authorized the completion of the plan approved in the Flood Control Act of June 30, 1948, in accordance with the report of the Chief of Engineers contained in House Document Numbered 185, Eighty-first Congress, for the Red River of the North Basin, at an estimated cost of $8,000,000.

c. Flood Control Act of 1970:

Notwithstanding the first proviso in section 201 of the Acts entitled “An Act authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes” approved June 30, 1948 (62 Stat. 1171) and May 17, 1950 (64 Stat. 63), the authorization in section 203 of the Act of June 30, 1948, and section 204 of the Act of May 17, 1950, of the project for local protection at East Grand Forks, Minnesota, shall expire on April 17, 1975, unless local interests shall before such date furnish assurances satisfactory to the Secretary of the Army that the required local cooperation in such project will be furnished.

The Federal project authority for conducting this General Reevaluation Report and Environmental Impact Statement is accomplished by resuming the flood reduction Planning, Engineering, and Design (PED) authority for the East Grand Forks, Minnesota, project which had been suspended in 1987. The study authority used to conduct this study comes from the reactivated East Grand Forks General Design Memorandum; the City of East Grand Forks requested that the 1986 study be reactivated and this was approved by the Assistant Secretary of the Army in May 1997, consistent with Corpswide PED reactivation policy. Flood reduction features in Grand Forks, North Dakota, are now being included in this rescoped PED East Grand Forks study. Specific funding for Federal participation in preparation of this report was provided through annual congressional appropriations bills.

Consistent with cost-sharing requirements established in the Water Resources Development Act of 1986 (Public Law 99-662), the cost of conducting this GRR will ultimately be cost-shared in accordance with the overall project construction.

The non-Federal share for the flood reduction features of the project will be not less than 35% and not more than 50% -- largely dependent on the cost of lands, easements, and rights-of-way needed to implement construction of the project as defined in the Water Resources Development Act of 1996.

Recreational features of the project are authorized as a separable part of the project by Public Law 89-72. These optional features of the project are to be cost-shared with the Local Sponsors being responsible for 50% of the implementation cost and 100% of operation, maintenance, and replacement costs, as defined in Public Law 99-662.

REPORT PURPOSE AND SCOPE

The St. Paul District, Corps of Engineers has completed this General Reevaluation Report and associated Environmental Impact Statement as a formal decision document. This report is intended to document reformulation studies that have been conducted by the St. Paul District, Corps of Engineers in cooperation with the cities of East Grand Forks and Grand Forks.

The purpose of this report has been to collect information about current conditions and to evaluate this in an effort to define a feasible and implementable Federal local flood protection project that would provide permanent flood protection for Grand Forks, North Dakota, and East Grand Forks, Minnesota. To accomplish this, an array of possible alternative plans were considered.

Study Area and System Unity

The "study/project area" focus for this local flood reduction report is upon the cities of Grand Forks, North Dakota and East Grand Forks, Minnesota (see project area map below). Grand Forks and East Grand Forks lie on the west and east banks, respectively, of the Red River of the North approximately 298 miles above the mouth of the river at Lake Winnipeg, Manitoba,

Canada. These cities are located at the confluence of the Red Lake River and the Red River of the North, and the Forks area is recognized as a regionally significant urban center.

The Grand Forks and East Grand Forks area is urbanized and intensive development exists along both riverbanks. All this development is susceptible to direct or indirect flood damages. Recent hydraulic evaluations show that flood reduction actions that would protect only portions of the study area would cause increases in flood stages and induced damages for the remaining unprotected portions of the study area. This is because the two cities are hydraulically unified.

Also, there is a strong grassroots desire of Grand Forks and East Grand Forks citizens and government officials to provide a consistent and high level of reliable flood protection to the entire East Grand Forks and Grand Forks area. This desire for a cities-wide flood protection system stems from the local understanding of their high risk for future flood inundation, the awareness of hydraulic unity/connection between the two cities, and a strong sense of community cohesion regarding the need to solve their flooding problem. This has led to a high priority by the community to find and implement permanent flood protection that is both high and uniform throughout the study area.

Summary Description of Flooding History

Throughout the early history of the two cities, floods were simply endured, with little organized effort being made to combat the muddy waters of the Red and Red Lake Rivers. Floodwaters frequently inundate large areas of the Red River Valley during the spring snowmelt and occasionally after heavy summer rains (see photographs of past floods that follow). As a result, private residences, transportation facilities, and businesses are all subjected to heavy damage. However, as low-lying areas along the rivers have become more urbanized, vast amounts of money have been spent on temporary and permanent flood-protection works and, when floods occur, on flood-damage repair and cleanup.

Downtown Grand Forks as the waters recede during the 1997 flood

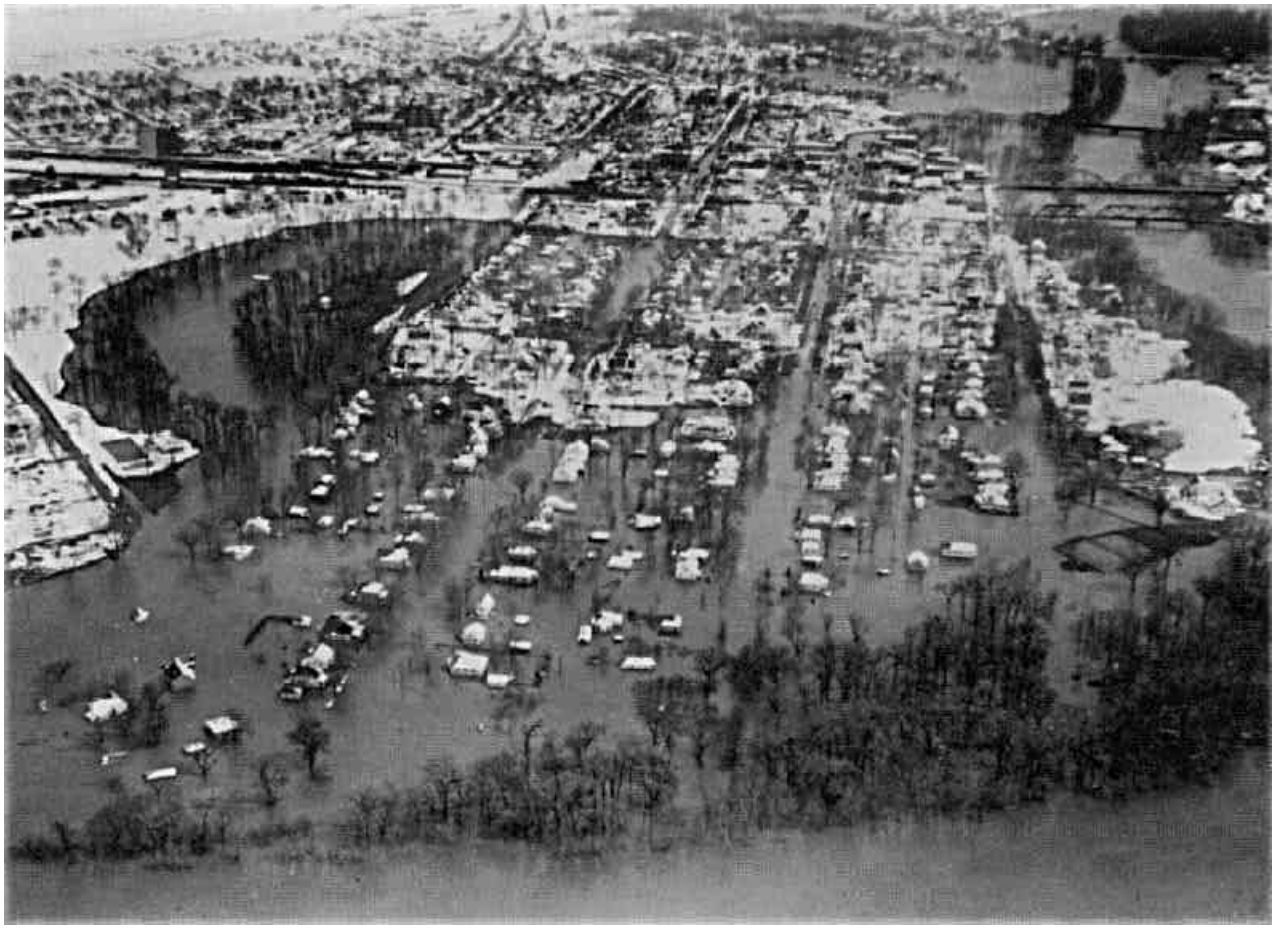
The Red River of the North is the largest river basin in the continental United States that drains into the Arctic Ocean. The total drainage area at East Grand Forks/Grand Forks is 30,100 square miles with an effective drainage area of 21,445 square miles.

Streamflow records date back to 1882; flood data prior to 1882 is limited. However, literature searches indicate that significant flooding occurred in the 19th century. Historic floods in 1826, 1852, and 1861 are documented in letters and journals with specific information regarding their magnitude and duration. The largest recorded flood occurred on April 18, 1997. It had an instantaneous peak of 136,900 cubic feet per second (cfs) with a stage of 52.21 feet (maximum stage was measured to be 54.35 feet on April 22nd). See appendix A of the supplementary documentation report for a listing of detailed discharge and elevation data of past floods in East Grand Forks/Grand Forks).

Fire and Water of the 1997 Flood

East Grand Forks During the 1979 Flood

East Grand Forks prepares for the 1965 Flood



East Grand Forks During the 1950 Flood

The Railroad Swing Bridge During the 1897 Flood

Demers Avenue during the Flood of 1897

PRIOR STUDIES, REPORTS, AND PROJECTS

The Corps of Engineers and other regional, State, and local entities have conducted numerous studies that are relevant to this planning and design report. A list of the studies that most influenced this study, in order of significance to this study, follows:

Flood Reduction Studies for East Grand Forks, Minnesota, and Grand Forks, North Dakota – Plan Comparison Letter Report, February 1998. The Corps of Engineers prepared this interim-screening document of the General Reevaluation Study. It was intended to define the most likely Federal flood reduction project for East Grand Forks/Grand Forks. It presented a more detailed comparison of the preliminarily defined National Economic Development Plan and the possible locally preferred plans. This report provided the basis for final screening of alternatives and allowed for a decision to be made about which plan would be carried into more detailed design for the remainder of the general reevaluation study.

Grand Forks/East Grand Forks Flood Reduction "Alternative Plans Comparison Evaluation" Letter Report, July 1997. The St. Paul District, Corps of Engineers prepared this initial technical assistance review of possible Federal flood reduction alternative plans. This initial interim document of the General Reevaluation Report was prepared within the first 3 months following the flood of 1997. This preliminary evaluation of possible remedial flood reduction plans compared major diversion plan alignments (North Dakota and Minnesota alignments) to a split flow diversion and a levee only option. This was used primarily as an initial screening tool for local decision making. This interim report provides the basis for more detailed evaluations documented in the February 1998 Plan Comparison Letter Report.

Feasibility Study for Local Flood Protection (Phase 2 Executive Summary Letter Report), 1995. In January 1994, the Corps of Engineers initiated a cost shared Feasibility Study. The final report for this study was scheduled to be completed in September 1997. It was never finalized due to the flood of 1997. However, the Phase 2 Executive Summary Letter Report was publicly released in November 1995. It was an interim report that showed documentation of screening efforts completed to define a Federal project for Grand Forks. This report showed that the most feasible Federal project was likely to be a permanent levee project that would provide part of Grand Forks with a 100-year level of protection.

Split Flow Diversion Evaluation – Main Report and Appendices – East Grand Forks/Grand Forks, February 1998. This interim report and supporting documentation was prepared by Short Elliott Hendrickson Incorporated (SEH), a consultant under to by the Corps of Engineers. This report detailed the best alignment, likely cost, and potential environmental effects of a diversion project aligned on the North Dakota side of the Red River. The information generated in this report was integrated into the Corps "Alternative Plans Comparison Letter Report" finalized in July 1997.

Reconnaissance Study for Local Flood Protection – Grand Forks, North Dakota, 1992. This Corps of Engineers study showed that there was likely to be a Federal interest in providing flood protection at Grand Forks. It concluded that the most feasible plan to be pursued in more detail was a levee plan.

Grand Forks – East Grand Forks Urban Water Resources Study, July 1981. This Corps of Engineers report documents and fostered interagency coordination regarding local flood reduction and water resources management opportunities, concerns, and possible remedial options for Grand Forks and East Grand Forks.

East Grand Forks General Design Memorandum, 1984. This Corps of Engineers detailed design report presents plans for a permanent local flood reduction project for portions of East Grand Forks. This plan included a nonstructural component that would evacuate/relocate a number of homes and businesses and a structural levee system that would provide a relatively high level of flood protection (156-year flood protection) for neighborhoods located north of the Red Lake River.

Environmental Impact Study of the Flood Control Impoundments in Northwestern Minnesota, July 1996. The Corps of Engineers and the Minnesota Department of Natural Resources prepared this document. It evaluated the potential for cumulative effects of constructing 33 proposed flood damage reduction impoundments in the Red River of the North basin. It determined that the cumulative effects of impoundments in

the Red Lake River basin can be beneficial and/or adverse - depending upon the resources being evaluated. Because it is a tier 1 (State Generic) EIS, there is a need for site specific evaluations of potential project related impacts.

General Reevaluation and Environmental Impact Statement for Flood Control and Related Purposes, Sheyenne River, North Dakota, April 1983. This Corps of Engineers study found that construction of recommended flood control improvements on the Sheyenne River would not significantly reduce flood stages at East Grand Forks/Grand Forks.

Twin Valley Lake Flood Control Study and EIS - Wild Rice River, Minnesota, 1984. This Corps of Engineers study and EIS findings of this study showed that the flood reduction improvements recommended on the Wild Rice River would not significantly reduce the flood problems at Grand Forks/East Grand Forks.

OVERVIEW OF PROJECT PLAN FORMULATION

Planning Goals and Process

Planning Goals

Local, State, and Federal flood management officials recognize the need to implement a permanent flood reduction project that protects both East Grand Forks and Grand Forks.

The plan formulation should take advantage of any secondary opportunities that a flood reduction project might offer (e.g., environmental restoration, recreation development, and associated greenway development in the open space area created by the buyouts associated with the 1997 flood).

To be implementable, the project must have the support of the Local Sponsor/s and a demonstrated Federal interest in implementation of the plan. In order to obtain Federal funding for a flood reduction project, the project formulation process must adhere to laws, policies, and regulations that define the planning and design process to be followed and establish specific design criteria and requirements. These criteria and requirements establish consistent standards for project designs and implementation/construction and assure that the project features will perform reliably.

General Planning Process Used

In order to effectively formulate a feasible flood reduction project and assess the effects of the project, a full array of potential flood protection strategies and associated specific plans must be considered. Plan comparison evaluations are done initially at a low level of detail, usually in a reconnaissance study. This study efforts focuses on determining if there is a potentially feasible plan that is in the Federal and local interest to pursue. If Federal and local interest is found, then studies of a greater level of detail are completed in feasibility and/reevaluation

studies. Flood protection plans found to be economically, environmentally, and socially feasible are evaluated further in a progressive screening process until a single “NED plan” can be defined and documented. One exception to this process is when a locally preferred plan is identified by the non-Federal Sponsors. Then, that plan is carried into progressively greater detail until the Local Sponsors determine it is no longer worthy of continued evaluation, or it is defined as the recommended plan and compared to the NED plan. This formulation process is documented as a decision document and assessed in an environmental assessment or impact statement. By using this "screening process," the total planning, environmental reporting, and design costs for a project can be formulated effectively and the most economically and socially feasible flood protection plan can be defined. This process also allows for public and interagency participation and review at numerous times in the planning/design process.

Flood Reduction Strategies Considered

Corps-wide planning guidance and sound planning principles require screening of an array of possible alternatives. The results of past flood reduction studies conducted on the Red River were researched for possible application, and many possible flood reduction strategies were considered for implementation at East Grand Forks and Grand Forks. Specific flood reduction strategies that were identified and considered included the following:

- A variety of downstream and in-town channel modification plans to deepen, widen, or straighten the river and thereby reduce flood stages.
- Bridge modifications (raising and/or removal) in the study area to reduce flood stage.
- A variety of diversion channel plans on both sides of the Red River of the North to carry floodwaters around the urban area.
- Basin-wide flood reduction measures such as upstream storage projects and what are sometimes referred to a “waffle plans” that would catch and hold floodwaters long enough to prevent flooding downstream at East Grand Forks/Grand Forks.
- Permanent levee/floodwall plans that would provide differing levels of flood protection for various East Grand Forks/Grand Forks neighborhoods.
- Nonstructural measures such as floodproofing to minimize flood damages, and relocation/evacuation of homes to place floodprone structures outside the floodplain.

Chronology of Screening Efforts and Overview Findings

In April 1990, the St. Paul District, Corps of Engineers began a Reconnaissance Study for Grand Forks. That report, finished in 1992, represents the starting point for the plan formulation screening efforts done as part of this report. Screening of potential alternative plans has been done repeatedly in order to find a feasible and implementable plan; the 1990-1992 Grand Forks Reconnaissance Study, the 1994-1996 Grand Forks Feasibility Study, and this study have progressively considered remedial flood reduction alternatives. During this study, initial screening of the possible flood reduction strategies resulted in a number of the possible flood reduction strategies being eliminated from further evaluation. The strategies eliminated and rationale for elimination in the initial screening process follow.

Basin-wide Flood Reduction Measures

Upstream/reservoir storage features were eliminated from detailed consideration in this study for a number of reasons:

- Past flood reduction studies and design capacity calculations have shown that it is not practical to expect upland storage to act as the primary flood reduction strategy at East Grand Forks and Grand Forks. The drainage area upstream of East Grand Forks and Grand Forks on the Red River is very large and very flat. This makes the magnitude of runoff storage required upstream of Grand Forks and East Grand Forks to be a significant engineering problem[1]. On the basis of these considerations, it was determined that upstream storage projects are not a good primary flood reduction strategy for Grand Forks or East Grand Forks, and they were not carried into detailed study. However, non-Federal upstream impoundments could provide a secondary long-range increment of safety and flood damage reduction for East Grand Forks and Grand Forks when combined with a permanent local levees flood reduction project.

Nonstructural Measures - Floodproofing and Relocation/Evacuation

Floodproofing would be costly and would provide a very limited level of protection if applied as the primary strategy for flood reduction at East Grand Forks and Grand Forks. Therefore, it was determined that this alternative would not be socially or economically acceptable for

[1] A major Federal flood reduction reservoir was studied for implementation on the Red Lake River in the 1970's. Such a project would have only reduced the flood stages at Grand Forks by 1.0 feet at peak stage during a 100-year flood. Similarly, two additional large Federal reservoirs previously studied for implementation on the Wild Rice and Sheyenne Rivers would only provide enough storage to reduce the 100-year flood stages in Grand Forks and East Grand Forks by an additional 1.0 feet. Later in the plan formulation of this report, a quick evaluation of two waffle plans was done to see what waffle plan storage requirements is likely to be. Findings of that analysis showed that from 1,120 to 2,150 square miles of additional storage of farmland would be needed as storage and this area would need to be flooded to a depth of 3 feet. That is 5 to 10% of the effective drainage area of the Red River and its tributaries that form the drainage area upstream of East Grand Forks/Grand Forks. Past basin-wide upstream storage studies have shown that large upstream storage reservoir projects have not been feasible from and economic, engineering, and/or environmental perspective. Also, if many smaller non-Federally operated reservoirs or waffle plans were implemented on the Red River of the North and it's tributaries in an attempt to control flooding, there would still be a problem certifying the flood reduction capacity of such projects from a Federal perspective. Specifically, each reservoir/storage area would need to be operated effectively for flood reduction and that would required a coordinated operating plan and then the projects would need to reliably maintained and operational to be effective when needed. Without Federal operation and oversight of such structures, the flood reduction affects of these impoundments could not be counted on and would be risky flood protection. Such a flood reduction strategy would not be likely to improve the Federal floodplain delineation's at Grand Forks and East Grand Forks. More evidence of the storage capacity problem is evident from the July 1996, EIS of Flood reduction Impoundments in Northwestern Minnesota. That study and document summarizes the possible impacts of flood reduction reservoirs on flood peaks and showed that the 20 Minnesota "reasonably foreseeable projects" upstream of EGF/GF would reduce the 100-yr peak discharge 1.12% and the peak stage 0.11 feet. These 20 projects would have a total flood pool volume of about 51,000 acre-feet. This is 1% of the 1997 volume (4,900,000 ac-ft) or the Red River at East Grand Forks /Grand Forks. It's reasonable to assume these 20 proposed reservoirs would not reduce the 1997 flood discharge more than about 1% and would not be an effective alternative for EGF/GF.

application in Grand Forks or East Grand Forks. Evacuation of structures was also not pursued beyond the initial screening phases because it would require the evacuation of thousands of structures to be effective and would not be socially acceptable. Interestingly, the flood of 1997 and the resulting buyouts of many structures that were most damaged by that flood has effectively caused evacuation of many homes and created open space in the floodplain.

Locally Preferred Plans Considered

After the temporary levee systems at East Grand Forks and Grand Forks overtopped during the 1997 flood, the Grand Forks feasibility study discontinued and there was growing local resistance to reliance upon levee systems for permanent protection. Local interest focused upon evaluation of a major diversion channel plan that could protect both cities. Acting on those hopes, the Mayors of Grand Forks and East Grand Forks and Congressional officials requested that the St. Paul District prepare a rough estimate of the costs and benefits for a number of diversion channel plans compared to a levees only plan. This information was needed to help the cities define the areas for property buyouts, delineate areas to limit reoccupation, and better define future open space. In response to these Local Sponsor requests, the Corps conducted intensive preliminary evaluations to compare three possible plans and provide the same assumed level of protection for each plan. The plans screened at this time included the following:

- A large diversion channel aligned to the east of East Grand Forks (referred to as the total diversion plan - Minnesota side).
- A large setback levee/floodwall system aligned along both sides of the river (referred to as the levees only plan or setback levees plan).
- A combination of a smaller diversion channel and lower height levee/floodwall plan (referred to as the Minnesota split-flow diversion plan).

The evaluation/screening of these plans was documented in an interim letter report called "Alternative Evaluation," May 29, 1997. The results of these plan comparisons were presented to city officials and local citizens on May 30, 1997. From the findings of the letter report, the setback levee plan evaluated at that time appeared to offer the most likely Federal flood reduction strategy and was economically feasible.

Local interest then shifted to looking at a diversion alignment that would follow a western alignment – west of Grand Forks. At the request of Grand Forks officials, the Corps evaluated a fourth alternative (the western aligned diversion plan). That screening effort resulted in economic, social, and engineering comparisons of the alternative plans. This information was publicly released in a Corps interim report called the "Comparison of Alternatives Letter Report," dated July 1997. The findings of those preliminary screening efforts by the Corps showed that a western aligned diversion would be the least cost effective plan, that the large setback levee was the most feasible plan, and that the split-flow diversion plan and the total diversion plan were substantially more expensive than the levee plan. With these findings, the Local Sponsors had enough information about possible locally preferred plans to eliminate a number of alternative plans. Specifically, due to major political and implementability complications, the large diversion channel aligned on the Minnesota side of the Red River was eliminated from further consideration as a locally preferred plan. Because of the local desire to proceed with a Federal flood reduction project, and the significance of the decision that faced the communities, the city councils of Grand Forks and East Grand

Forks requested on August 11 and 12, respectively, that the Corps of Engineers proceed with a more detailed evaluation and design of the levees only flood protection project. They also requested that concurrent detailed evaluations of a western diversion be undertaken to determine its feasibility. At this point in coordination with the Local Sponsors, it was clear that they wanted to fully evaluate possible Locally Preferred Plans as well as to define the National Economic Development (NED) plan so they would be able to pick the plan that is in the best local interest. The decision as to which plan should be pursued and ultimately recommended was a local and Federal concern and was an especially difficult decision for the directly affected community. In September 1997, at the request of the North Dakota Congressional Delegation, a more detailed western split-flow diversion evaluation was initiated by the Corps, with assistance from its consultant SEH.

Both plans were designed to protect the communities from an event with the same amount of water as the 1997 flood - approximately 137,000 cfs (normal river flow is about 4,000 cfs). The levees-only plan involved a series of levees and floodwalls throughout the two communities. The split-flow diversion originally included a diversion channel routed on the North Dakota side to carry about half of the water during a design event. This plan would also include levees through the communities that would protect to a 100-year flood event. The levees were included because construction of the diversion channel was expected to take 15 to 20 years and the communities wanted some level of protection during the interim. For both plans, the city councils agreed to consider the downtown pedestrian bridge removed – to reduce stages outside of the study area and eliminate induced damages from the project. The remaining three vehicular bridges and the two railroad bridges would remain and would not be affected/changed by the project.

Over the next few months, a detailed comparison was made of this final array of alternatives. These final screening evaluations were completed in February 1998 and the findings were presented in an interim report called the “Plan Comparison Letter Report.” The findings presented in that report showed conclusively that the split-flow diversion plans evaluated were not cost effective and that the levees only alternative was feasible. The preliminary findings [2] indicated:

- The levees-only plan would cost about $300 million (not including the cost of greenway development) and had a benefit/cost ratio of 1.13. This ratio meant that there would likely be a Federal interest in paying for part of the project. For this project, it would be about a 50/50 cost share between the Federal and non-Federal entities. Construction of the project would take about 4 to 5 years and would affect a total of about 350 structures on both sides of the river (excluding structures already bought out due to the 1997 flood).
- The split-flow western diversion plan would cost about $900 million and had a benefit/cost ratio of 0.4. This meant that it was extremely unlikely that the Federal Government would help pay the costs. Construction would take 4 to 5 years for the I00-year levees portion and 10 years for the diversion channel. Construction of the diversion channel would begin after the levees were completed.

[2] The designs and cost estimates presented at this point in the study process were subject to change and would be refined and revised after the detailed cost engineering of the project is completed.

Specific Objectives, Opportunities, and Concerns

An important aspect of formulating a plan for flood reduction is to inventory the specific objectives, opportunities, and concerns of the stakeholders involved in implementation of a future permanent project. Key objectives, concerns, and opportunities identified during the course of the study are listed below:

OBJECTIVE - The primary objective of this study is to define an implementable permanent flood protection project that will significantly reduce the long-term risk of catastrophic flood damages to Grand Forks, North Dakota, and East Grand Forks, Minnesota. This project needs to be technically feasible from an engineering and economic perspective

OBJECTIVE – Another important objective to a project so as not to induce damages to the "opposite side of the river" from any proposed project features in the study area or to areas upstream or downstream of the study area. In response to this objective, hydraulic project design criteria were established in order to avoid flood reduction actions that would cause upstream or downstream induced stage impacts. This resulted in inclusion of the remove of the pedestrian bridge to accomplish this objective. The project was also formulated as a single hydraulic unit because of the high potential for induced damages within the project area if a protection were provided on only one side of the river.

CONCERN - After the temporary levee systems at Grand Forks and East Grand Forks were overtopped during the 1997 flood, there was growing local concern about reliance upon levee systems for permanent protection. Because the Winnipeg diversion project was able to protect that city from the 1997 flood, there was local interest in formulation of a major diversion channel plan that could protect both cities. As a result of these concerns, the Corps completed comparative evaluations of a number possible diversion plans that would reduce or eliminate levees in town. However, ultimately the Local Sponsors found that these plans were too expensive to build or were not implementable, and they were not recommended.

CONCERN – There was a strong local desire to remove or raise existing bridges to reduce flood stages in town. Due in part to this concern of citizens and local officials, a hydraulic analysis of the impacts of the bridges through East Grand Forks/Grand Forks was completed in May 1997 as part of this study. This evaluation found that if all the bridges, other than the Kennedy Bridge, were removed completely, the maximum potential impact would be immediately upstream of the Point Bridge with a reduction in water surface elevation of 1.5 feet. This potential reduction was reduced to 1.0 foot at the upstream end of the project. Because these bridges are needed, they would need to be elevated substantially to approach the potential stage reductions identified if the bridges were totally removed. The detailed analysis of the actual cost of raising these bridges and constructing the associated modifications to existing roads or railroad track approaches was not done. However, a quick review of these costs convinced Corps designers that the total costs of raising the bridges would be much higher than raising the proposed levees the extra 1.0 to 1.5 feet. It is also important to note that, with the removal of the existing pedestrian bridge (old railroad swing bridge) that is already a part of the proposed project, a reduction of 0.5 foot of the potential 1.5 feet in potential stage reduction is being realized by the project. Therefore, the potential stage reduction possible by raising the remaining railroad and highway bridges is likely to be 1.0 foot or less.

CONCERN – Historic preservation interests and some local citizens wish to preserve the existing pedestrian swing bridge (old railroad bridge). This bridge has been recommended for removal early in the plan formulation process because it is an important means of reducing stage effects outside the study area and because it will reduce flood damages in a cost-effective manner. In August 1997, the City Councils of Grand Forks and East Grand Forks accepted the removal of the bridge as a part of the NED plan to be detailed in this report by the Corps. Removal of the bridge would allow the top elevation of the proposed levees to be approximately 0.5 foot lower and this would economically

reduce the impacts to commercial and residential structures. The historical and recreational significance of the bridge is recognized and efforts to coordinate the mitigation of the structure are being pursued as part of the EIS coordination. Also, the proposed greenway development being included as part of the Federal project would functionally replace the recreational use provided by the bridge; two pedestrian/bike bridges will be constructed across the Red River at Riverside Park and at Lincoln Park.

CONCERN - Approximately 25 percent of Grand Forks surface lands are located in the current 100-year regulatory floodplain and about 40 percent of East Grand Forks is currently within the floodplain. However, as a result of recent Red River floods (especially the 1997 flood), the regulation floodplain needs to be updated, and it is scheduled to be remapped by the Federal Emergency Management Agency (FEMA) within the next few years. When completed, almost all the land surface in East Grand Forks and Grand Forks will be in the new 100-year regulatory floodplain (this larger floodplain assumes that no permanent flood reduction project is implemented).

CONCERN – Citizens and city officials are concerned about the probable negative spiral effect that another major flood or floods would have on the community. Specifically, if a major flood breached the existing temporary levee system, many structures would be damaged to the point where the structure would need to be condemned and removed. Another traumatic flood event with damages at East Grand Forks and Grand Forks would be very difficult to overcome; From the social and economic perspective, the concern is that these flood induced actions would significantly decrease community and neighborhood cohesion, adversely affect local property value and the tax base, and likely result in a decline in the community population.

CONCERN - From the engineering perspective, the major geotechnical constraint is the poor riverbank and levee foundation stability (see geotechnical Appendix B for technical details). The instability is caused by a combination of the geologic and geomorphologic conditions in the area. A typical location where stability is of greatest concern is on the outside of a meander in the river, where erosional forces are highest. The erosional nature of the river, combined with the weak lacustrine soils deposited in the geologic past, contributes to the riverbank and levee foundation stability problems throughout the Grand Forks and East Grand Forks area. Levees located near or on the outside of meanders will most likely need to be set back several hundred feet from the riverbank, resulting in removal of houses and other related structures. Floodwalls and modular wall designs have already been used in numerous locations along the project alignments presented in this report in the ongoing efforts to avoid impacts to structures and critical infrastructure such as roads and utilities. A number of additional potential techniques to move the levees/floodwalls riverward to protect additional existing structures are being analyzed but are not available for this report. When those detailed evaluations are complete, they will be used to refine the project alignments where it is possible -- from an economic, engineering, and environmental perspective. These detailed evaluations will require additional field data collection and analysis that is now under way. However, the results of these efforts will not be available until mid-summer 1999 and the extent of future riverward movement of the project alignments expected to be possible as a result of these evaluations is likely to be limited to small reaches.

CONCERN- A potential environmental issue that could affect project design is the potential presence of hazardous, toxic, or radioactive waste (HTRW) materials. To assess the study area for potential HTRW materials, and for other contaminated materials which may not meet the strict definition of HTRW materials, an Environmental Site History was completed for Grand Forks and Phase I Environmental Site Assessments (ESAs) were completed for both Grand Forks and East Grand Forks. The Phase I ESAs were completed in accordance with ASTM 1527-97. The ESAs identified six sites in Grand Forks and two sites in East Grand Forks, which have potential environmental concern. Of these eight sites, only one of the sites is considered to have the potential to encounter materials which meet the strict definition of HTRW materials, and only a small portion (10 percent, for estimating purposes) of that site is assumed to meet the strict definition of HTRW materials. While the remaining sites have been determined to have the

potential to encounter contaminated materials, with little or no potential to encounter materials which meet the strict definition of HTRW materials, Phase II investigations are ongoing to verify the nature of the materials that may be encountered at the those sites.

CONCERN - A number of historically/culturally significant structures located on the current project alignment will be affected by the project. The extent of the impacts is not yet fully defined because additional evaluations will be done in the remaining detailed design phases in an effort of avoid or minimize the damages to such structures.

OPPORTUNITY - A number of historically/culturally significant structures could be protected from high risk of flooding as a result of implementing a major permanent project. This would provide an opportunity to protect those structures from future floods.

OPPORTUNITY - The Riverside Dam creates a pool upstream into the study area. This pool provides aesthetic and recreational opportunities and serves to stabilize the riverbanks and levees in Grand Forks and East Grand Forks. The riverbanks adjacent to the dam are very erodible and unstable, and the integrity of the structure could be undermined if actions are not taken to control this condition. Because the area has a substantial amount of high valued property along the riverbanks, the recommended flood reduction project includes riprapping this reach of the river to protect the toe of the riverbanks and allow protection of most of these properties. The secondary effects of riprapping the riverbed and riverbank toe are that this action helps to protect the structural integrity of the dam. This riprapping also acts as a good foundation from which a potential future fish movement structure could be constructed (i.e., there is interest in implementing a boulder design fish movement structure on the downstream side of the existing dam).

OPPORTUNITY - Water resource studies conducted by Federal, watershed, State, and local levels of government have identified the recurrent flooding of Grand Forks and East Grand Forks as a critical problem in the Red Lake River basin. Minnesota and North Dakota have also recognized the importance of flood protection for these communities. The States have taken steps to assist the cities in funding this study and preparing detailed design reports, plans and specifications, and have indicated a willingness to assist in the construction of project features to substantially reduce the cities' financial costs. The combined financial resources of identified non-Federal and Federal sponsors make a significant permanent project possible.

OPPORTUNITY - Substantial areas near the Red and Red Lake Rivers in East Grand Forks and Grand Forks were impacted severely affected by the flood of 1997. Much of this area has already been purchased from the landowners. This is clearly a traumatic experience for the people directly affected by the flood and buyouts. But, the buyouts provided public open space near the river that offers new opportunities for setback levees, greenway development, and reclaimed environmental habitat.

ARRAY OF PLANS CONSIDERED

An array of potential permanent Federal plans were specifically considered at various times during the plan formulation process. A listing of these and a short screening rationale for each plan follows:

Specific Plans	Summary Description of Plan	Study Findings
English Coulee Closure Plans	A closure structure to prevent Red River floodwaters from backing into the coulee and to allow interior drainage if a levee is placed along the Red River.	Was evaluated as an interior flood control feature of the NED plan. Is now integrated into the NED plan.
50-year level of Levees/Floodwall Plans in East Grand Forks and Grand Forks	A low-level citywide levee system for East Grand Forks and Grand Forks was evaluated in progressively greater detail throughout this study.	Early reconnaissance and feasibility studies showed that this alternative could be economically, socially, and environmentally feasible. During screening of the final array of alternatives, this plan was determined to be marginally infeasible.
100-year level of Levees/Floodwall Plans in East Grand Forks and Grand Forks	A citywide levee system on the Grand Forks side was evaluated in progressively greater detail throughout this study. Formulation of this plan has merit from a local flood insurance perspective.	Early reconnaissance and feasibility studies showed that this alternative could be economically, socially, and environmentally feasible. During screening of the final array of alternatives, this plan was not determined to be as cost-effective as the 210-year level of protection.
210-year level of Levees/Floodwall Plans in East Grand Forks and Grand Forks	A citywide levee system on the Grand Forks side was evaluated in progressively greater detail throughout this study. Formulation of this plan has merit from a local flood insurance perspective. This plan was identified by the local sponsor as a locally preferred plan.	Detailed screening evaluations done as part of the General Reevaluation Report showed that this alternative would be economically, socially, and environmentally feasible. During screening of the final array of alternatives, this plan was found to have the highest net benefits of any plan evaluated (is the NED Plan).
	Table continued on next page	

North Dakota (Western) Aligned Diversion Channel Plan	A diversion channel that would be built west of Grand Forks to allow floodwaters to pass safely around the community. This plan was initially looked at in the Grand Forks Reconnaissance study, and a split-flow variation of it was included as one of the final array of plans evaluated - as a possible locally preferred plan.	Corps evaluations have consistently concluded that this alternatives is not economically feasible. The detailed evaluation of this plan done in February 1998 had enough detail to assure the Local Sponsors that pursuing this plan was not practical.
Minnesota Aligned Diversion Channel Plan	A diversion channel that would be built east of East Grand Forks to allow floodwaters to pass safely around the community. Variations of this plan were considered as possible locally preferred plans.	Corps evaluations of this alternative concluded that this alternative is not socially or economically feasible. The screening evaluations of this plan completed in July 1997 caused the Local Sponsor to withdraw this plan from further consideration.
In-town Channel Modifications	A variety of in-town channel modifications were detailed. These included a 900-, 1,200-, and 1,500-foot-wide channel through the study area.	The stage reduction possible from these features was not significant and they were determined to be economically, environmentally, and socially infeasible.
Downstream Channel Modifications	A variety of downstream channel modifications were detailed. These included a 900-, 1,200-, and 1,500-foot-wide channel downstream of East Grand Forks/Grand Forks.	These features did not significantly reduce flood stages in the study area and were found to be environmentally and economically infeasible.

Final Array of Plans Evaluated

After public comment and discussions with the non-Federal Sponsors following presentation of the Alternative Plans Comparison Evaluation Report (July 1997), it was determined that three alternative plans were worthy of more detailed consideration. The plans considered

further include two Locally Preferred Plans (LPP) that were identified early in the final screening phase by the non-Federal Sponsors and a detailed optimization of the levees only plan that was determined in prior economic evaluations to be the National Economic Development plan. These plans were the final array of plans that were evaluated and the evaluations done on these plans were more detailed than those of previous screening efforts. Specific information about the final array of alternatives follows.

Locally Preferred Plans Identified and Evaluated

In an effort to narrow the number of LPP plans to be detailed and to shorten the time frame for implementation of a permanent flood protection project, the Local Sponsors defined only two Locally Preferred Plans for consideration, as follows:

1. A permanent levee and floodwall system that would provide protection against future floods of a magnitude similar to the 1997 flood - This plan, sometimes referred to as the levees only plan, would provide reliable permanent flood protection for all areas of East Grand Forks and Grand Forks. This plan has an 86% reliability of containing the 210-year flood event (0.47 % exceedance frequency), equates to a Red River discharge event of 136,900 cfs, and a river stage of 58.5 at the in-town gage - without superiority. This plan would remove the protected areas of East Grand Forks and Grand Forks from the 100-year regulatory floodplain. It also would provide a solid foundation and alignment for future emergency flood fighting measures in the event of flooding that exceeds the permanent structure design capacity.

2. A split-flow diversion channel and permanent levees plan - This plan, often referred to as the split-flow diversion plan, is a multi-featured plan that would provide reliable permanent flood protection for all areas of East Grand Forks and Grand Forks. It consists of an in-town levee system and a large diversion channel located on a North Dakota alignment. The combined effect of these features is to provide greater than 95% reliability of containing a 500-year flood event (0.2% exceedance frequency). This LPP would be designed and operated so that in-town flood stage would be limited to a 51-foot river stage up to a Red River discharge of 136,900 cfs at the gage in town. Because the levee system component of this plan is a 100-year (1.0% exceedance frequency) permanent levee design without the diversion channel in place, it provides additional floodwater discharge capacity over the 51-foot stage and provides protection against much larger floods without resorting to emergency flood protection measures. Therefore, compared to the levees only plan described this split-flow diversion and levees plan would provide an extra measure of safety and reliability. This plan would be implemented in construction phases and the initial phase could stand-alone (the levee could perform while the diversion channel was being constructed). This initial levee construction phase would remove most areas of East Grand Forks and Grand Forks from the 100-year regulatory floodplain, without reliance on the diversion channel features. This in-town levees plan would also provide a foundation and alignment for future emergency flood fighting measures in the event of flooding that exceeds the permanent structure design capacity.

National Economic Development (NED) Plan

Further plan refinements will be conducted throughout the reevaluation phase and these refinements may alter project materials, design, cost, and cost apportionment or Federal participation in the project or any of its components.

Federal and Corps planning procedures require the formulation of a NED plan. The NED plan is an optimized plan that provides the greatest net benefits and has a benefits-to-cost ratio of at least 1.0. This is the plan against which any requested betterments are compared. To define the NED plan, it was necessary to optimize the selected levee plan. To do this optimization, a range of levee system designs with differing elevations were evaluated from a cost and benefit perspective. Specifically, designs and associated costs were prepared for levee plans that would reliably protect against floods of a 50-year (2.0% exceedance frequency), a 100-year (1.0% exceedance frequency), and a 210-year (0.47% exceedance frequency) level flood design. The net benefits associated with each of these plans were then compared to define the optimized design elevation. This NED/optimized design is typically the plan that the Federal Government recommends for construction. Generally, the cost of implementation of the identified NED plan is the level of Federal interest in funding a water project.

The study team conducted screening evaluations to accurately select a single plan from the array of evaluated plans. Then, an important part of the study effort was completed -- This was the optimization evaluation to determine the optimal height of the levees only plan and the reliability of the protection against specific flood events. Those evaluations determined that the 210-year level of flood protection was the optimal project size. To determine the optimal height, three different levee designs capacities/heights were evaluated. A 50-year, a 100-year, and a 210-year (1997 flood level) event were evaluated in detail. The benefits and costs of each were defined and the plan with the greatest net benefits was identified. An evaluation of potential, larger than 210-year plan projects, was also accomplished but these larger projects were found to be uneconomical and socially unacceptable[3]. The findings of the NED optimization efforts, completed in February 1998, are summarized in the following table.

[3] The residual benefits possible from a project providing flood protection greater than the 210-year are low (i.e., only approximately $1,428,000 average annual damages are residual beyond the 210-year plan which is about 6% of the total average annual damages). The project features proposed for the 210-year plan provides a very solid foundation for future successful flood fighting efforts for floods that exceed the design capacity (especially in view of the long lead time on the Red River to implement emergency flood measures). A quick evaluation of probable costs to raise the level of protect showed that the cost a larger project would increase substantially and would not be incrementally offset by the associated benefits. Therefore, a larger project is not desirable from the Federal economic perspective. Also, it was found that, from the local perspective, construction of a larger project would result in substantial and unacceptable adverse social impacts (i.e., the taking of additional structures and increasing local construction and operations costs are not politically or socially acceptable).

Alternative Plans Compared	*Cost of Evaluated Project*	*Benefits to Costs Ratio*	*Anticipated Social Considerations*
50-Year (2.0% exceedance frequency) **Levees Only**	$213.4 Million	B/C somewhat under 1.0 but is not considered economically feasible	Plan would take 35 single family and 4 commercial in EGF and 151 single family and 4 commercial buildings in GF. Would not remove protected areas from the regulatory floodplain.
100-Year (1.0% exceedance frequency) **Levees Only**	$225.3 Million	B/C slightly lower than 1.0 (marginally feasible)	Plan would take 35 single family and 4 commercial in EGF and 151 single family and 4 commercial buildings in GF.
210-Year (0.47% exceedance frequency) **Levees Only**	$256.2 Million	Has most net benefits and a 1.2 B/C ratio	Plan would take 35 single family and 4 commercial in EGF and 151 single family and 4 commercial buildings in GF. Represents the optimized NED and is also the plan identified as locally preferred.

Findings of the Optimization Evaluations

Additional Neighborhood Alignment Evaluations

In addition to using optimization to define the reliability of protection and the level of protection that is justified as the NED plan, a detailed process of evaluating river reaches and neighborhoods was used to determine the specific alignment that was economically justified. Along the entire project, the most cost-effective alignment (i.e., the alignment with the greatest net benefits) was identified and this is the alignment that is presented in this report. During this study, the NED plan alignment changed in a number of areas as a result of progressively more detailed screening evaluations of the alignments and the possible neighborhood reaches that might be protected. Key alignment evaluations conducted and the resulting alignment effects follow.

Grand Forks Side

- The south end alignment was extended southward approximately 1 mile from County Road 17 to the Merrifield Road (County Road 6). This was done because fill requirements

and utility costs associated with construction along the Merrifield Road alignment were less costly than providing the southern line of protection on County Road 17.

- The East Lake Estates, L&S Subdivision, and Shady Ridge Estates (all in Grand Forks County) were evaluated from an economic and hydraulic perspective and a change to include these areas inside the line of flood protection was found not to be feasible. These could be looked at as possible betterments when future detailed construction reports are coordinated. However, it is important to note that the alignment the County prefers and would include the most homes would cause significant increases is water stages during flood events and is therefore not consistent with our hydraulic design criteria.

East Grand Forks Side

- The area extending from the north side of 23rd Street Northwest to 1 mile north of 23rd Street Northwest, including the sewage treatment system, and proceeding east on the county/township road. Evaluation of this alignment and other alignment northward showed that the alignment 1-mile north of the highway is not economically feasible. However, as a result of other northward alignment analysis, an alignment that parallels 23rd Street Northwest and is one-half mile north of the highway was defined as a likely feasible alignment and is shown as the NED alignment in this report. Additional detailed analysis will be needed to confirm that this is the NED alignment. If this alignment is determined not to be feasible, the Local Sponsor has indicated that the alignment shown in this report will be pursued as a betterment alignment.

- An area located south of the southend water tower and east of the new high school, extending along the north-south township road, and one lot width south of the township road that is at the end of the city limits was evaluated and found to be not feasible. It could be pursued as a betterment during future detailed design and construction phases.

The remainder of the formulation process, from February 1998 through July 1998 focused on preparing a detailed design and cost estimate for the selected NED levees only plan. To accomplish the detailed design, intensive coordination of the final alignments was needed to assure that design criteria and constraints were integrated. The resulting plan was then documented as the recommended plan in this General Reevaluation Report.

Detailed Design Criteria and Constraints

Federal design procedures require adherence to laws, policies, and regulations that define general and specific design guidance requirements. These criteria and requirements establish nationwide consistent standards for project design and project construction. Adhering to design guidance requirements insures that Federal permanent project features will perform reliably and that projects being considered for implementation are fairly represented to Congress.

Local design procedures and design criteria were also provided to the Corps design team for integration into the project design. Local standards for road design, public utility designs, desired maximum levee heights, and floodwall alignment criteria that related to planned local

emergency flood fighting features were integrated into the project alignment designs presented in this report.

Immediately following the devastation in Grand Forks and East Grand Forks resulting from the flood of 1997, high level Corps officials coordinated with Office of Management and Budget (OMB) and Congressional officials. These efforts resulted in plan design agreements and interpretations that have to some extent shaped plan formulation for this study. Key formulation/design assumptions resulting from these discussions include the following:

- The real estate buyouts required as a result of the 1997 flood are being considered a part of existing conditions and will not be a cost attributable to the permanent flood reduction project.
- A limited NED plan will be done as part of a GRR, and this involves using existing data whenever possible. NED optimization will be done along a single project alignment.
- For benefit calculating purposes, structures located landward of proposed levees are assumed to be repaired in kind and in place at pre-flood values[4].
- If the Local Sponsor decides to pursue an LPP alternative plan that is different from the NED plan, an NED exception request will be submitted to the Assistant Secretary of the Army (Civil Works) for consideration.

During the final screening of alternatives, specific design criteria used to design levees and floodwall plans deviated somewhat from the criteria used for formulating and designing the diversion channel and tieback levees plans. Design criteria used for each type of project feature are presented as follows.

Levees and Floodwalls Plans

Using engineering inventories and analysis, the Corps technical design team and the Local Sponsors worked closely to identify the alignments for the in-town levees and floodwalls. The initial project alignments were presented to the City Councils and other local, State, and Federal officials on December 10, 1997, for the portions downstream of Red Lake River and on January 7, 1998, for the river reaches upstream of and on the Red Lake River. Refined alignments have been coordinated with local officials through July 1998. Specific levee/floodwall alignments, types of flood protection features proposed, and associated details and section drawings for the in-town levee/floodwall alignments are shown on the plates at the end of this report.

The design team used critical design criteria to define the best alignment for each reach. The most important criteria used to determine the levee alignment was a combination of the geotechnical stability of the levee foundations and the hydraulic capacity of the river channel. These key criteria were used to define the initial levee alignments. To do this, detailed inventory and analysis of the stability of the levee foundations was accomplished for each reach of the project to define the minimum levee setbacks required (see Appendix B of the Supplementary Documentation Report for geotechnical data and technical evaluations). Detailed modeling of the river hydraulic capacity and effective flow was integrated into the

[4] Substantially damaged residential structures were evaluated for location benefits.

initial setback requirement line (see Appendix A of the Supplementary Documentation Report for hydraulic data and technical evaluations).

Next, important secondary criteria were applied by Corps and Local Sponsor engineering team members to refine and adjust the required levee alignment setback line for each project reach. The secondary criteria applied included the following:

- Minimizing the cost of an effective engineering solution[5]. Cost comparisons between levees, floodwalls, and a modified levee section, referred to as a Modified Stabilized Earth (MSE)[6] wall in this report and on the report plates, were evaluated to identify the most cost effective alignment for each reach. This alignment takes into account the costs of the levees, floodwalls, and MSE walls; the costs of real estate/structures associated with the differing alignments; and the cost of utilities, roads, and other infrastructure.
- Avoiding historical structures wherever possible. Historically significant structures were afforded extra engineering design efforts to avoid impacts to them. If such structures are adversely affected, mitigation costs may be needed and these become a cost shared project cost if they exceed 1% [7]of the total project costs.
- Considering system integrity. This includes minimizing the levee height (desired maximum of 10 feet), placing floodwalls only in areas where emergency dike construction can be easily accomplished, and considering potential river flow induced erosion -- especially on sharp turns of the river.
- Maintaining infrastructure. Consideration was given to existing and post-project condition utilities and road systems to insure that an economical and practical design for maintaining these services was integrated into the alignments.

Split-Flow Diversion and Levees Plans

Short Elliott Hendrickson (SEH) Incorporated, a Minnesota-based Architect-Engineering firm, was hired by the Corps of Engineers to conduct detailed evaluations of the non-Federal Sponsor defined LPP split-flow diversion and levees plan. SEH used the hydrologic and hydraulic design parameters provided by the Corps and the Local Sponsor (see detailed

[5] Generally, the least costly alignment is a single alignment that is in the best Federal interest and must be shown as part of the NED plan. Exceptions to this approach are possible when special environmental or historical resources can be avoided with special engineering or in areas where the non-Federal Sponsor chooses to take a more costly design approach and agrees to pay for the additional cost (referred to as a betterment). The incremental increased cost of a betterment, above the NED costs for that feature, is paid for by the non-Federal Sponsor (100% non-Federal cost).

[6] The modified levee section consists of a levee prism on the riverward side of the flood barrier and an MSE wall on the landward side of the flood barrier. An MSE wall is a retaining wall, which consists of segmental retaining wall units, commonly referred to as modular blocks, and a geogrid-reinforced backfill. The immediate benefit of using an MSE wall is a gain of the space previously occupied by the landward side of the levee prism. This space can be used more effectively for other needs, such as possibly saving a structure, or for infrastructure requirements.

[7] The costs of mitigation associated with cultural/historical impacts of a project are a Federal cost up to 1% of the total project cost. Such costs that exceed 1% are cost shared as features of the project.

description of these assumed criteria in Appendix J of the Supplementary Documentation Report or refer to the summary of these criteria presented in the LPP description).

The SEH design team first analyzed previous Corps and Acres International [8]studies and diversion channel alignments using an HEC-2 hydraulic subroutine that determined the quantity of excavation for the various plans being analyzed. Then, on the basis of these initial hydraulic sensitivity model runs, it was determined that a 51-foot river stage at the gage in town would be acceptable during a 1997 flood event (136,900 cfs event). This differed from the initial assumption of a 49-foot river stage in town during a flood event of 136,900 cfs and was used to size the dimensions of the diversion channel.

SEH and the Corps then completed a variety of engineering and environmental inventories and analyses. The SEH design team used critical design criteria to define the best channel design configuration and alignment for a split-flow diversion plan, consistent with Corps of Engineers mandated criteria found in the contract scope of work. The design criteria that were evaluated and analyzed as part of the contracted work included real estate and existing structures displacements, comparative excavation requirements, environmentally sensitive areas to avoid, ability to maintain downstream and upstream water surface profiles, and anticipated operation and maintenance costs.

Geotechnical conditions were determined to be the greatest concern and constraint on determining the designs for channel alignment, channel cross section, and design of other related structures such as bridges and water control features. Much of the area has a high groundwater table and soil lenses which will allow water movement to the channel as excavation occurs. Also, stability of the channel side slopes is critical because of the low shear strengths of the native clays and silts.

Using this information, alternative diversion alignment plans were screened and coordinated with Local Sponsor representatives and a single "best" diversion channel was defined. This best North Dakota diversion alignment and its associated features were evaluated and costed in more detail. The screening process and the details regarding the "best" North Dakota diversion alignment plan were then presented to the City Councils on December 10, 1997. Specific diversion channel alignments evaluated and the best alignment and associated technical details and section drawings are shown in technical Appendix J of the supplementary documentation report.

In order to meet Corpswide regulations, the detailed designs for levees used a detailed risk and uncertainty analysis procedure to determine the height of levees relative to the design water surface elevation. A confidence interval is established around the various design parameters, and a quantitative analysis is performed to assure that the top of levees have a 90% probability of containing the design event. In addition a superiority elevation is added to assure that any overtopping event occurs first at the downstream end of the project.

[8] Acres International Limited, a consultant based in Winnipeg, Manitoba, was hired in August 1997 by the Grand Forks Mayor's Business Redevelopment Task Force to review the North Dakota aligned diversion plans presented by the Corps in July 1997. Acres proposed a different diversion alignment and design than the Corps and estimated a lower cost of construction.

Detailed Description of the Proposed Project

NED plan Features

The optimized levees plan defined in the final screening was further designed, costed, and assessed from an environmental perspective in the final phase of the plan formulation (see plates 1-164 contained at the back of this report for graphic display of the plan and profiles of the proposed project). This plan, referred to as the NED plan, is a multi-purpose project that would provide reliable permanent flood protection for all areas of East Grand Forks and Grand Forks and consists of a permanent levee and floodwall system (a magnitude similar to the 1997 flood). This plan has an 86% reliability of containing the 210-year flood event (0.47 % exceedance frequency), equates to a Red River discharge event of 136,900 cfs, and a river stage of 58.5 without superiority at the in-town gage. This plan would remove the protected areas of East Grand Forks and Grand Forks from the 100-year regulatory floodplain. It also would provide a solid foundation and alignment for future emergency flood fighting measures in the event of flooding that exceeds the permanent structure design capacity. The NED plan includes greenway/recreational trail and day use facility development, removal of an existing pedestrian bridge, and channel diversions features on the English and Hartsville (also referred to as Heartsville) Coulees.

A summary quantification of the multi-featured NED plan follows.

The project will require a total of approximately 735 acres of fee title real estate interests of unimproved and city owned properties; and the acquisition of 252 single family residences, 95 apartment or condominium units, and 16 businesses.

The project requires the relocation of numerous utilities, including electrical, sewer, and water lines. The project requires the relocation of a portion of the Grand Forks, water treatment plant. The features that will require relocation are the raw water works (water intake facility), the sludge plant, and a water storage tank. Three lift stations and the water plant lime treatment ponds must be relocated in East Grand Forks. For this project, 26 road raises will be required. A currently non-functional pedestrian bridge will be removed as part of this project. Over 3 miles of road raises will be undertaken.

Two diversion channels will be excavated for this project. The first will be a 3.5-mile extension of the existing English Coulee Diversion west of Grand Forks to intercept the English Coulee and a second smaller coulee. The section of the English Coulee Diversion downstream of this extension will be expanded to appropriately manage the additional discharge. The diversion extension will range in bottom width from 30 to 60 feet, the existing coulee will be expanded to 80 feet in bottom width, and side slopes will be I vertical on 5 horizontal. A second diversion channel will be excavated south of the Point area in East Grand Forks to carry flows from the Hartsville Coulee directly into the Red River rather than through East Grand Forks to the Red Lake River. This diversion will be 1.2 miles in length with a bottom width of 20 feet and side slopes of I on 7. A drop structure will be required at the riverward end of each diversion. Riprap

will be placed along a number of locations on the Red River to provide bank stabilization.

The project includes the construction of new levees, floodwalls, and mechanically stabilized earth levee sections, and the removal of previously constructed emergency levees and one previously constructed Federal levee and floodwall reach. Details of the levee and floodwall construction are provided in the General Evaluation Report and are summarized below.

Levee Reach	Length (mi)	Maximum height (ft)
Grand Forks		
- Levee	7.7	22
- Floodwall	1.0	8
- MSE	0.5	8
East Grand Forks - North End		
- Levee	10.5	23
- Floodwall	0.1	14
East Grand Forks - Point		
- Levee	6.0	21
- Floodwall	0.8	8

This project requires the modification of existing interior flood control facilities throughout both cities. Final modifications of the interior flood control facilities will be addressed in the Interior Flood Control Detailed Design Memorandum.

The project includes the acquisition and demolition of over 300 residential structures and numerous businesses for the levee alignment. It is anticipated that some of these structures were constructed using materials containing asbestos. The project will include sampling, testing, removal, and disposal of the asbestos material. Additionally, the levee alignment will go through a predominantly urban area that has had historic industrial uses. Therefore, it will be necessary to complete a sampling and testing plan to assess the impacts of HTRW along the proposed alignment. A Phase II sampling plan was completed and will be initiated in the summer of 1998.

Further plan refinements will be conducted throughout the reevaluation phase and these refinements may alter project materials, design, cost, and cost apportionment or Federal participation in the project or any of its components.

Final Benefits and Costs

A detailed cost estimate, referred to as a baseline or MCASES cost estimate, was prepared very near the finalization of this study in order to accurately define the project costs (see Appendix D for the Cost Engineering breakouts prepared for the cost of implementing the NED plan). The total cost of the recommended multipurpose project, in December 97 dollars, is $308,871,000 (this is the project cost used for economic feasibility determinations). The cost to benefit ratio has been defined for both the basic project and for the separable recreation increment and the B/C ratios are 1.12 and 2.18 respectively.

Using this timeframe for defining project feasibility, the overall benefits to costs ratio for the NED plan has been calculated to be 1.16. However, it is important that the cost estimate account for higher future construction costs expected when the project is to be implemented. Accordingly, the project costs have been inflated to arrive at a "fully funded" construction cost of $342,738,000 (assumes that project construction would begin late in 2000 and would be completed in 6 years and includes recreation and cultural resources mitigation costs). A summary of the fully funded/adjusted total construction costs to implement all cost features of the combined NED plan is shown in table x (see Appendix D, Cost Engineering for greater detail).

The summary of average annual costs and benefits for the recommended “97 flood” levees flood reduction plan is presented in the following table (see the Economic-Social-Financial Appendix for technical information regarding the benefits analysis).

SUMMARY OF AVERAGE ANNUAL COSTS AND BENEFITS
97 Flood Levee

	Flood Control	Recreation	Total Project
Total First Cost	$301,360,000	$7,511,000	$308,871,000
IDC	70,100,000	1,612,000	71,712,000
Total Investment	371,460,000	9,123,000	380,583,000
Annualized First Costs	27,342,093	671,518	28,013,611
Annual O&M Cost	1,260,000	337,000	1,597,000
Average Annual Charges	28,602,000	1,009,000	29,611,000
Avg. Annual Benefits			
Damage Reduction			
Residential	16,345,200		16,345,200
Commercial/Industrial/Public	8,163,200		8,163,200
Vehicles	139,900		139,900
Infrastructure	380,000		380,000
Costs Avoided			
Transportation Disruptions	0		0
Emergency Response	2,724,000		2,724,000
Other Household Costs	671,500		671,500
Business/Income Losses	0		0
Flood Insurance Admin. Costs	393,000		393,000
Redevelopment Benefits			0
Advanced Replacement	2,810,500	69,000	2,879,500
Location	403,600		403,600
Recreation		2,130,600	2,130,600
Total Annual Benefits	32,030,900	2,199,600	34,230,500
Net Benefits	3,428,900	1,190,600	4,619,500
B/C Ratio	1.12	2.18	1.16

Assumptions: 1. Assumes a 50 year project life - 7 1/8% interest rate.
2. December 1997 price levels.

PRELIMINARY PROJECT MANAGEMENT PLAN

Recommended Plan Cost Allocations

The estimated cost allocation/distribution of implementing the recommended levee plan is shown in the following table. Note that recreation is shown as a separable feature line item in this table.

COST DISTRIBUTION

EAST GRAND FORKS, MN / GRAND FORKS, ND
LOCAL FLOOD REDUCTION

TOTAL PROJECT COST ESTIMATE	**$ 342,738,000** [9]
Federal Project Costs	**$ 171,917,500**
Non-Federal Project Costs	**$ 170,820,500**
EAST GRAND FORKS, MN	
Lands, Damages, and Relocations	$ 46,479.000
Cash Contributions	$ 6,139,700
Recreation features	$ 2,101,000
Sub-Total	**$ 54,719,700**
GRAND FORKS, ND	
Lands, Damages, and Relocations	$ 94,680,900
Cash Contributions [10]	$ 19,297,900
Recreation features	$ 2,122,000
Sub-Total	**$ 116,100,800**

[9] This total project cost is inclusive of recreation features and cultural resource preservation mitigation costs.

[10] Cash contribution includes 5% of total flood control project plus $8,777,800 for non-Federal sponsor balance

Preliminary Financial Analysis

The Cities of East Grand Forks, Minnesota, and Grand Forks, North Dakota, will serve as the non-Federal/Local Sponsors for the implementation of this flood damage reduction project. The City of East Grand Forks has previously served as local sponsor for the cost-share of a General Design Memorandum (November 1984), and the City of Grand Forks was serving as a local sponsor for the cost share of a Feasibility Report at the time of the April 1997 flood of record. During the course of these earlier studies, the cities repeatedly demonstrated the necessary skills to accomplish the technical, administrative, logistical, and political requirements in an efficient and professional manner. The State of Minnesota has committed through legislation to provide financial support in the form of bonds and returned sales taxes to the City of East Grand Forks to assist in the payment of its local share. The State of North Dakota has committed in the form of a verbal and written commitment from the current Governor to provide financial assistance to the City of Grand Forks to assist in the payment of its local share. See the Economic Appendix of the Supplementary Documentation Report for additional details regarding the financial plan to implement the recommended project.

The non-Federal Sponsors have the capability to finance their share of the cost of constructing this local flood protection project (for details see the financial analysis contained in the Economic-Social-Financial Appendix C of the Supplementary Documentation Report). The non-Federal Sponsors are ready, willing and able to fulfill all the responsibilities required to serve as the non-Federal sponsor for this project, including obtaining the necessary real estate interests, providing the required cost sharing funds, and operating and maintaining the project upon completion. The Cities have reviewed the Standard Form Project Cooperation Agreement, and understands and agrees to its provisions.

Local Cooperation Requirements

The division of planning, implementation, and operation responsibilities, including local cooperation requirements, institutional requirements, and other non-Federal responsibilities, will be further coordinated as the Local Cooperation Agreement and the Project Management Plan are formalized after this report is completed.

The Water Resources Development Act of 1996 establishes the cost-sharing requirements for this project; the non-Federal share to a minimum of 35 percent and a maximum of 50% for implementation costs associated with flood damage reduction.

It is recommended that improvements for flood damage reduction defined in this report be authorized subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including the following requirements:

(1) Provide a minimum of 35 percent, but not to exceed 50 percent, of total project costs allocable to structural flood control and 50 percent of total project costs allocable to recreation, as further specified below:

(a) Enter into an agreement which provides, prior to construction, 25 percent of design costs;

(b) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(c) Provide, during construction, a cash contribution equal to 5 percent of total project costs attributable to structural flood control;

(d) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(e) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(f) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of total project costs allocable to structural flood control and 50 percent of total project costs allocable to recreation.

(2) For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government.

(3) Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

(4) Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project=s authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

(5) Support the Government=s obligation to comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

(6) Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

(7) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

(8) Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

(9) Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

(10) As between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

(11) Prevent future encroachments on project lands, easements, and rights-of-way which might interfere with the proper functioning of the project.

(12) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

(13) Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of flood plain management plans.

(14) Provide the non-Federal share of total cultural resource preservation mitigation and data recovery costs attributable to structural flood control and to recreation that are in excess of
one percent of the total amount authorized to be appropriated for structural flood control and recreation.

(15) Participate in and comply with applicable Federal floodplain management and flood insurance programs.

(16) Do not use Federal funds to meet the non-Federal sponsor=s share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

(17) Inform affected interests, at least annually, regarding the limitations of the projection afforded by the project.

(18) Prescribe and enforce regulations to prevent obstruction of or encroachment on the Project that would reduce the level of protection it affords or that would hinder operation or maintenance of the Project.

(19) Provide and maintain necessary access roads, parking areas and other public use facilities, open and available to all on equal terms.

The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the Local Sponsors, the state of Minnesota, the state of North Dakota,

interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Implementation of the project will require the continued dedication of the cities and their staffs. The following tabulation summarizes the non-Federal activities and completion dates needed to satisfy the local cooperation requirements.

ITEMS	*DATES*
Review Pedestrian Bridge Removal Plans and Specs	06/99
Review English Coulee Design Memorandum	07/99
Review Geotechnical Engineering Letter Report	08/99
Review Hartsville Coulee Design Memorandum	09/99
Negotiate Project Cooperation Agreement (PCA) [11]	09/99
Execute Project Cooperation Agreement	10/99
Review Channel Protection Plans and Specs	12/99
Review Interior Flood Control Design Memorandum	01/00
Review Geotechnical Design Memorandum	02/00
Review English Coulee Diversion Plans and Specs	03/00
Review Hartsville Coulee Diversion Plans and Specs	05/00
Review Point-East Grand Forks Levee Plans and Specs	
Phase I - River levees	12/00
Phase II - Tieback levees	01/02
Review Grand Forks Levee Plans and Specification	
Phase I - Upstream Tieback to Belmont Coulee	01/01
Phase II - Belmont Coulee to Minnesota Avenue	01/02
Phase III - Minnesota Avenue to Highway 2	01/03
Phase IV - Highway 2 to Downstream Tiebacks	01/04
Review North End - EGF Plans and Specifications	
Phase I - Red Lake River Levees to Downtown	03/01
Phase II- Downtown to Downstream End	03/02
Phase III - Tieback levees	02/03
Acquisition of LERRDs	Immediately prior to Phase Construction
Submit LERRDs claim	10/03
Turn Over to Sponsor	10/04
Operate and Maintain Project	N/A

Construction Staging and Schedule

Key Construction Phasing Assumptions:

1. The first construction contract will be removal of the swing bridge.

[11] A detailed model Project Cooperation Agreement (PCA) for the proposed project was provided to the non-Federal Sponsors on April 30, 1998, to insure that there is a complete understanding of the language and provisions contained in that agreement.

2. The second construction contract will be for erosion protection riprapping and this feature of the project will need to go directly from the GRR to P&S. The P&S for this work will need to be finalized in early FY2000 and the construction should be ready to award by mid to late FY2000.
3. The third construction contract will be for English Coulee project features.
4. The fourth construction contract/phase will be for Hartsville Coulee project features.
5. The remaining construction phases will be for the levee construction reaches going from upstream to downstream and for associated interior flood control features.

Operations and Maintenance Requirements

Local interests would operate and maintain the project in accordance with the procedures and schedules set forth in an Operation and Maintenance manual that the Corps of Engineers will prepare and provide. The total estimated annual cost of operations and maintenance for the NED plan is $564,000 (includes flood control and recreation features). Maintenance would consist of periodic inspections of and repairs to the project permanent levees, interior drainage facilities, recreation facilities, and channel diversions. Operations would include the operation of pumping stations and gates and the servicing of all project structures, including landscaping.

STUDY PARTICIPANTS AND PUBLIC INVOLVEMENT

Interagency and Public Coordination

An experienced and diverse interdisciplinary study team comprised of Corps of Engineers engineers and scientists and non-Federal Sponsor technical representatives has been heavily involved on a regular/weekly basis in the preparation and coordination of this study. The Corps and the Local Sponsors also hired private consultants at strategic points to assist in the formulation, evaluation, and review of this study. Many other local, State, and Federal officials and individual citizens have also had an opportunity to provide important ideas or inputs into some aspect of the inventory, analysis, or formulation of the plans presented in this report.

Efforts to maintain good communications between potential project sponsors and stakeholders were fostered through structured partnering workshops and meetings that were conducted from October 1997 through February 1998.

On January 8, 1998, a structured interagency and sponsor greenway brainstorming workshop was conducted by the Corps with the assistance of the Grand Forks Parks Commission. This was a kickoff meeting to begin formulation of a coordinated greenway plan for East Grand

Forks and Grand Forks. Additional interagency, sponsor, and public involvement was sought to finalize a greenway plan in the spring of 1998.

The public has been informed about the progress made in the study efforts on a regular basis using a number of methods:

- Many issues of the "Flood Protection Update" newsletter have been prepared and distributed by the City of Grand Forks with assistance from the City of East Grand Forks and the St. Paul District, Corps of Engineers. These have received wide distribution, and the information contained in them is often covered in the local media.
- Numerous neighborhood meetings/workshops were held in Grand Forks and East Grand Forks in November 1997 to provide information to interested citizens and to obtain public ideas and concerns.
- Corps/Sponsor presentations and public workshops/open houses have been conducted at key points in the formulation of plans associated with the Federal flood protection GRR. The dates of these public gatherings and the primary information presented at each are as follows:

  - **May 5, 1997** - Preliminary levee alignments were presented to give residents an idea of how a levee project might affect them.
  - **May 30, 1997** - Preliminary levee alignments were presented to the joint City Council and questions were answered.
  - **July 14, 1997** - A preliminary letter report known as the "Alternative Plans Comparison Letter Report" was presented to the cities. It provided initial Corps screening of alternatives, including diversion channel and levee plans.
  - **December 10 - 11, 1997** - Presentation of the SEH[12] diversion alignments and the Corps in-town levee alignments for reaches downstream of the Red Lake River (Public officials from all levels of government in the area were fully briefed on the 10th and a public workshop/open house was conducted on the 11th).
  - **January 7 - 8, 1998** - Presentation of Corps in-town levee alignments for reaches upstream of and on the Red Lake River (Public officials from all levels of government in the area were fully briefed on the 7th and a public workshop/open house was conducted on the 8th).
  - **February 9, 1998** – Town Hall meeting for residents to provide inputs and ask questions about the city's flood recovery.
  - **February 12, 1998** – Corps presentation of final Plans Comparison Letter Report to local, State, and Federal representatives. Question and answer session.
  - **February 18 - 19, 1998** – Public meeting to answer questions regarding findings of the Plan Comparison Letter Report.
  - **March 24, 1998** – Meeting for property owners in Grand Forks regarding Phase IV acquisition program and the Federal acquisition program.
  - **March 11 - 12, 1998 –** Greenways public workshop/open house meetings.
  - **March 31, 1998** – Meeting for owners of property located south of Grand Forks

[12] Short Elliott Hendrickson (SEH) Incorporated, a Minnesota-based Architect-Engineering firm hired by the Corps of Engineers.

to discuss alignment issues and concerns.

- **April 21, 1998** – Meeting with County Commission to discuss south-end alignment preferences of residents.
- **April 22, 1998** – Meeting to discuss concerns of residents located north of Grand Forks regarding dike alignments and the English Coulee Diversion plans.
- **April 30, 1998** – Meeting of Special Flood Response Committee to discuss analysis of City consultants regarding geotechnical issues and potential technologies. Include question and answer session.

The Draft General Reevaluation Report and Environmental Impact Statement will be distributed for a 45-day public/interagency review in August 1998 and public workshops/open house meetings will be conducted to present findings and obtain public comment. Comments received will be integrated into the final report and EIS, which is scheduled for public release and a final comment period in early November 1998. The finalized report is scheduled to be submitted to Corps of Engineers Headquarters in December 1998 for higher authority approvals.

See the Environmental Impact Statement for scoping related views and comments received from citizens and interested agencies. Also, a more detailed technical description of other study related coordination and review comments is contained in Appendix L, "Correspondence and Review Comments" of the supplementary documentation report.

INVENTORY, ANALYSIS, AND STUDY FINDINGS

This section of the report presents a summary of the key technical procedures and considerations associated with the plan formulation and recommended plan/project design. This information is presented by functional discipline and/or key feature of the project (Note: For more detailed technical data and analysis, see the Supplementary Documentation Report (volumes 1 and 2) which are companion documents to this report. The Supplementary Documentation Report is available as a reference at the East Grand Forks City Hall, Grand Forks City Hall, and public libraries in the Grand Forks area.

Hydrologic

Hydrologic analyses for the East Grand Forks-Grand Forks study area included development of discharge-frequency relationships at several locations. Annual instantaneous peak discharge-frequency curves were developed for the Red River of the North at the U.S. Geological Survey (USGS) gaging station at Grand Forks, North Dakota, located just downstream of the confluence with the Red Lake River, the Red River of the North above the confluence with the Red Lake River, and the Red Lake River at the mouth. The corresponding coincidental peak discharge-frequency curves were developed for the same locations. The statistics of the frequency relationships were based on period of record flows at the U.S. Geological Survey gaging stations located on the Red River at Grand Forks and on the Red Lake River at Crookston, Minnesota.

Analyses also included determination of the discharge-frequency curve for the English Coulee watershed. English Coulee is an intermittent stream that enters Grand Forks from the southwest and joins the Red River of the North approximately 4 miles downstream from the mouth of the Red Lake River. Because the watershed is ungaged, a multiple linear regression was used to determine the discharge-frequency relationship for English Coulee.

A discharge-frequency relationship based on regression equations was also computed for Hartsville Coulee that drains an area of approximately 33 square miles in Minnesota and joins the Red Lake River in East Grand Forks, Minnesota.

Detailed discussions of the hydrologic methods used along with the derived frequency relationships are provided in Appendix A, Hydrologic, Hydraulic, Risk-Based, and Interior Flood Control Analysis, Sub-Appendix A1, Hydrologic Analysis. More detailed discussions of the hydrologic study methods for English Coulee and Hartsville Coulee will be presented in future separate design memorandums.

Hydraulic

The East Grand Forks, Minnesota and Grand Forks, North Dakota, areas are hydraulically unified. The hydraulic unity of East Grand Forks and Grand Forks must be considered in two separate pieces as the East Grand Forks area is protected by two independent ring levees - the North End and the Point areas.

North of the existing pedestrian bridge (old railroad swing bridge), scheduled for removal as part of the flood damage reduction project, there would be notable stage increases for the design discharge by building levees on either side of the river independently. This is not considered acceptable, and justifies the construction of the Grand Forks and North End East Grand Forks levees as one hydraulic unit. Also, immediately upstream of the mouth of the Red Lake River, hydraulic modeling shows there is a stage increase during the overtopping event. This establishes a critical hydraulic connection between the Grand Forks and the Point East Grand Forks levee sections. Therefore, the Grand Forks, East Grand Forks (north end), and East Grand Forks Point (south end) are all interlinked as one hydraulic unit for purposes of this report and incremental justification or optimization of the project features is neither necessary nor appropriate.

Immediately upstream of the mouth of the Red Lake River there is also a stage increase noted during the overtopping event that identifies the connection between the Grand Forks and the Point East Grand Forks levee sections.

Hydraulic analysis performed for this study includes modeling of the Red River of the North and the Red Lake River; determining levee/floodwall heights, designing facilities to accommodate flow in Hartsville Coulee and prevent breakout flow from the Red River to Hartsville Coulee; and redesigning the existing English Coulee diversion channel to accommodate the additional flow that will be directed to it with the proposed levee project. The Red River of the North and Red Lake River modeling included updating and calibrating the HEC-2 computer models and iteratively analyzing levee alignments to determine alignments that meet hydraulic and geotechnical requirements. Detailed discussions of the

hydraulic analysis are provided in Appendix A, Hydrologic, Hydraulics, Risk-Based, and Interior Flood Control Analysis, Sub-Appendix A2, Hydraulic Analysis.

A risk-based analysis was performed using @RISK and a template spreadsheet developed by the Hydrologic Engineering Center. The @RISK models developed were used to determine the reliability of the alternative levee heights and the diversion channel in combination with levees. These models were also provided to the Economics Section to perform the project sizing analysis. Discharge-frequency relationships were determined for both the levees only and the diversion channel in combination with levees. Elevation-discharge rating curves were developed at five different locations. Four of these locations were used to determine project reliability and project sizing for all of the alternatives. The fifth location was used to help determine the reliability of the diversion channel in combination with levees. Detailed discussions of the risk-based analysis are provided in Appendix A, Hydrologic, Hydraulics, Risk-Based, and Interior Flood Control Analysis, Sub-Appendix A3, Risk-Based Analysis.

Analysis was performed to determine the impact of the emergency levee alignments, project levee alignments, removal of the pedestrian bridge and raising of the four other bridges. The analysis was performed using the 1997 flood peak discharge of 136,900-cfs (0.47-percent, 210-year event). When raising the four other bridges was considered, it was assumed they were raised high enough that the low chord of the bridges was 1 to 2 feet above the water surface elevations. This analysis is presented in more detail in Appendix A, Hydrologic, Hydraulics, Risk-Based, and Interior Flood Control Analysis, Sub-Appendix A2, Hydraulic Analysis.

The first condition analyzed was assuming the existing emergency levees were raised high enough to contain the 1997 flood peak discharge and all existing bridges in place. This condition was analyzed even though a substantial raise would be required and even though the reliability assessment of the existing emergency levees indicates probable failure points generally equal to about the 5-percent (20-year) event. The next condition analyzed was project levee alignments and all existing bridges in place. With project levee alignments, water surface elevations are lower than for the emergency levee alignments except in the Riverside Park area where they are slightly higher. The change in water surface elevations with the project levee alignments ranges from an increase of about 0.1 foot in the Riverside Park area to a decrease of about 1.4 feet in the vicinity of 47th Avenue South. The next condition analyzed was the project levee alignments with removal of the pedestrian bridge that is the design condition used for this report. This results in water surface elevations about 0.6 foot lower at the USGS gage, 0.4 foot lower in the vicinity of 47th Avenue South, but only 0.2 foot lower at the upstream end of the project. Note that these comparisons are to the condition with project levee alignments but all existing bridges in place.

Next, raising the Sorlie Memorial Bridge and widening it about 50 feet was considered. When compared to the design condition, this results in water surface elevation increases of about 0.1 foot at the USGS gage which reduce to essentially nothing at the upstream end of the project. The reason that raising the Sorlie Memorial Bridge actually raises water surface elevations instead of decreasing them is because the approach road raises which must be done to raise the bridge eliminate flow around both sides of the bridge. Since raising the Sorlie Memorial Bridge actually raised water surface elevations slightly, it was not considered further. Next, raising the Kennedy Memorial Bridge was considered in addition to the design condition. Raising the Kennedy Memorial Bridge lowered water surface elevations about 0.25

foot at the USGS gage and upstream of the railroad bridge, about 0.2 foot at 47th Avenue South, and 0.1 foot at the upstream end of the project. Then, two changes were considered for the railroad bridge. These changes include raising the bridge and replacing the river piers with narrower piers. These changes result in an additional decrease in water surface elevations of about 0.2 feet upstream of the railroad bridge, about 0.1 foot at 47th Avenue South, and less than 0.1 foot at the upstream end of the project. The total reduction in water surface elevations due to raising both the Kennedy Memorial and railroad bridges is about 0.25 foot at the USGS gage, about 0.45 foot just upstream of the railroad bridge, about 0.3 foot at 47th Avenue South, and about 0.2 foot at the upstream end of the project. Finally, raising the Point Bridge was considered. Raising this bridge had essentially no impact on upstream water surface elevations. The approach road raises eliminate flow around both sides of the bridge, similar to the Sorlie Memorial Bridge, which offsets the increase in channel flow area.

This analysis shows that raising the Sorlie Memorial and Point Bridges does not lower water surface elevations due to approach road raises that are required. Raising the Kennedy Memorial and railroad bridges does lower water surface elevations, but only a relatively small amount. This analysis also shows that the impact of the bridges on the top-of-levee elevations is relatively minor and the bridge raises would likely cost more than building the levees slightly higher. During more detailed studies, analysis will be performed to insure the Sorlie Memorial Bridge can withstand the water and ice loads placed on it and that it will remain in place. However, the 0.47-percent (210-year) design water surface elevation for this project is only about 1.6 feet higher than during the 1997 flood event at the Sorlie Memorial Bridge. Therefore, impacts on the bridge should be similar to those that occurred during the 1997 flood. This analysis also shows that if a bridge is raised to maintain access between the cities, it would be logical to raise the Kennedy Memorial Bridge, not the Sorlie Memorial Bridge. In summary, this analysis generally shows that raising the bridges is not a cost effective means of lowering the water surface and top-of-levee elevations.

An evaluation of residual flooding was accomplished based on risk analysis and it was determined that the proposed project has about a 63-percent probability of containing the 0.2-percent (500-year) flood event. The 0.2-percent event is essentially equal to the overtopping event. The analysis also showed that residual flooding would encompass the entire protected and developed areas of East Grand Forks. In Grand Forks inundation would be to an elevation of about 835 and this would leave a portion of the south end of Grand Forks out of the flooded area (see Appendix A and plate A2-23 of the Hydraulic Appendix for flooded area map of the affected areas and additional descriptions of residual flooding).

A detailed evaluation of sedimentation potentials in the Red River was not accomplished as part of this study. This was deemed to be unnecessary based on Corps and non-Federal Sponsor historic knowledge of the specific resource. Soundings and river cross-sections collected over a long period of time that pass through the study area have not changed substantially over time and river sediment deposition has not affected the flow capacity of the river (see the Hydraulic Appendix in the Supplementary Documentation report for more information).

Interior Flood Control

Interior flood control facilities will be required to permit removal of stormwater runoff from within the three protected areas. The interior flood control analyses determined the number, location and size of all gated outlets and intercepting storm sewers required to carry the runoff from the protected area through the flood barrier to either the Red River of the North or the Red Lake River during periods of low river flow and new pumping (lift) stations to carry the interior runoff over the flood barrier during periods of high river flows. The total estimated cost of the preliminary interior flood control facilities exceeds $45,000,000. Due to time and data constraints only a preliminary analysis was done for this report. Conservative design assumptions were used and it is expected that detailed design efforts will result in a reduction in the proposed interior flood control facilities.

The gravity (low river) features, gated outlets and intercepting sewers are designed to pass the interior runoff from the 1-percent (100-year) rainfall event through the barrier. Use of the 1-percent design will reduce or eliminate residual flooded areas that would remain in the regulatory floodplain. The existing stormwater facilities carrying interior flow to the barrier are designed for smaller floods and would not be able to carry the 1-percent flow to the barrier. However, the design assumed the excess water would flow overland to the barrier. For this analysis, topographic data was not available to determine if this overland flow would really reach the barrier or if it would be stored in low areas within the cities.

The blocked gravity (high river) features, pump stations and stormwater ponding areas are designed to eliminate all interior flooding damages most intense historical rainfall event which would have occurred with the selected gate closure level. The selected gate closure level was assumed to be about to two to three feet below the existing ground level adjacent to the closure structure.

The interior flood control design proposes 16 pump stations, ranging from 2,200 to 67,300 gallons per minute (gpm) and averaging 13,600 gpm; 50 gated outlets, ranging from one 30-inch to 11 60-inch pipes; and about 2.5 miles of storm sewers to intercept and collect flows at the barrier. The design also includes ditches and designated ponding areas. The preliminary interior flood control plan for each of the proposed protected areas is presented in Appendix A.

The detailed interior flood control design will be done in a design memorandum in Preconstruction Engineering and Design (PED). In accordance with guidance in EM 1110-2-1413, the “minimum” interior facility considered integral to the line-of-protection would be determined. For gravity conditions, the minimum gated outlets will probably match the existing stormwater outlet sizes. It is anticipated the final gravity conditions design will still be for the 1-percent event. Previous optimization efforts by the St. Paul District have found little size difference or cost savings in using smaller design floods for gravity outlets. Large cost savings are expected in the gravity design by refining the flow that actually reaches the barrier during a one percent event and by optimizing the trade-offs between gravity outlets, intercepting storm sewers and ponding areas.

The blocked gravity pumping stations and ponding areas will be optimized in detailed design. Using new elevation-discharge-duration data for the rivers, new topographic maps, and current elevation-damage information for the protected areas, the blocked gravity facilities will

be sized based on a period of record economic analysis. Since all required pumping stations, except those located at the outlets from English and Belmont Coulees, are to be located in the proposed outlet gatewell, the largest cost savings for blocked conditions design should come from optimizing the tradeoffs between gate closure elevations, pumping stations, ponding and intercepting stormsewers.

Geotechnical Design and Geology

GEOLOGY

The basis for most of the geotechnical stability analysis prepared for this report is a direct result of the geologic setting of the present day Red River Valley. Glaciers advanced into and retreated from the Red River Valley several times during the Pleistocene Epoch. Glacial advances deposited sandy, pebble tills, while glacial retreats resulted in trapped meltwater, creating Glacial Lake Agassiz. Approximately 70 feet of high plasticity glacio-lacustrine clays were deposited on the bed of Lake Agassiz. These clays are the cause of most of the stability problems encountered along the rivers in the present day valley.

After Lake Agassiz drained for the final time, the present day Red River of the North and its tributaries established themselves on the flat topography of Glacial Lake Agassiz. The relatively undeveloped Red River drainage system may be likened to a shallow scratch in a broad table top. A veneer of predominately fine grained alluvial and fluvial overbank deposits have been placed over the lake clays by the Red River and its tributaries since the end of the glacial episodes. These recent sediments do not exceed about 45 feet in thickness, and are typically less.

SITE GEOMORPHOLOGY AND ITS RELATIONSHIP TO SLOPE INSTABILITY

GENERAL

All rivers tend to flow in a sinuous pattern known as a meander belt. This is because water flow is turbulent, and any bend or irregularity in the channel deflects the flow of water to the opposite bank. The force of the water striking the stream bank causes erosion and undercutting. Studies have shown that the velocity and turbulence are at a maximum on the outside of meander bends. Erosional forces are therefore maximized on the outside or cutting edge of these bends. Experience and observation indicates that one of the most critical areas for the development of unstable slope conditions in the Red River Valley is along the outside end of river bends, and especially at the downstream end of these bends. On the inside of the meander velocity and turbulence is at a minimum, so that some of the sediment load may be deposited as alluvial/fluvial soils on the point of the meander and are called point bars. The crescent shaped bars are mostly composed of material derived from bank caving on the outside of upstream bends. An examination of the soils in the borings along the river valleys was undertaken in an attempt to determine which stream processes, erosion or deposition, are dominant along a given stretch of river.

SUMMARY

The Red and Red Lake Rivers are actively eroding and depositing sediment. The meander bends are migrating now, and have in the past. Erosional forces are maximized on the outside of meander bends, while deposition dominates on the inside. Additional aerial photography analysis may help to determine the rate of meander belt migration; however, photos inspected to date indicate that little migration has occurred within the past 30 to 40 years. Subtle “points” of relatively thick, weak glacial clays (Sherack and Brenna Formation), located at the downstream ends of outer meander bends are the most critical areas for any construction activity or riverbank modification. Soil borings reveal that the entire length of all outer meander bends contain buried failure surfaces. Many of these slopes are apparently stable now. These buried surfaces, which are planes of weakness, must be carefully analyzed so that slope failures are not reactivated.

SITE HYDROGEOLOGY

The generally low permeability of the soils within the proposed project boundaries make determination and prediction of groundwater levels challenging. Occasionally some fluvial seams near the river are sufficiently pervious to allow a confident measurement, however this does not yield much useful information about the interaction between the river water surface and the overbank groundwater conditions. Earlier efforts to correlate soil color with groundwater conditions are now thought to be unreliable. In an attempt to obtain more useful groundwater information, the subsurface investigation methods used to obtain site hydrogeology information was modified. The information gathered has helped to shed light on this problem; the results are still not entirely definitive.

Groundwater levels in the Grand Forks/East Grand Forks area are high, within approximately 5 to 20 feet below the ground surface at the top of the secondary (upper) bank. Riverward of the secondary bank, the water levels are correspondingly closer to the ground surface, with an approximate range of 4 to 9 feet below ground surface at the primary (lower) bank. Water levels fluctuate seasonally, with fall /winter conditions exhibiting the lowest measured water levels as might be expected. The water surface profile from the secondary bank riverward varies also, with the flattest profile occurring during the fall/winter months. Water levels in the banks do fluctuate with the level in the river; however data is not available to ascertain the rate at which the banks become saturated with river water.

GEOTECHNICAL DESIGN

General

The primary geotechnical design concern is constructing flood barriers consisting of earthen levee embankments or floodwalls along the marginally stable secondary river banks. The soft, weak, high plasticity glacio-lacustrine foundation clays within the project limits often do not adequately support flood barriers built next to the river. Natural geologic processes and prior construction activities by man have overloaded many of the riverbanks, resulting in foundation movements and slope failures. These past movements and failures result in further reductions in the shear strength of the already weak foundation clays.

The geotechnical design process required determining a flood barrier alignment and flood barrier type that would not result in foundation movements or slope failures, while at the same time attempting to minimize impacts to existing structures. Three flood barrier types were utilized to minimize the number of structures impacted by the flood barrier alignment: earthen levee; concrete floodwall; and a modified levee section comprising an earthen levee prism on the riverward side of the flood barrier and a mechanically stabilized earth wall (MSEW) on the landward side of the flood barrier. Slope stability was analyzed at 49 cross section throughout the project to determine the flood barrier alignment.

Subsurface Investigations and Laboratory Testing

In support of the geotechnical design process, 121 machine soil borings were advanced during the period 1994 to present. In addition, information from 31 machine soil borings advanced between 1980 and 1985 in support of various studies in East Grand Forks was utilized. Laboratory testing consisting of S (CD), R (CU), Q (UU), unconfined compression, Atterberg limits, moisture content, and consolidation tests was conducted on undisturbed samples obtained from these borings. Countless jar samples obtained from the borings were tested for Atterberg limits and moisture content in an effort to delineate the different soil units used in the geotechnical analyses. Geotechnical design parameters were developed from the laboratory test results.

Design Criteria

Slope stability design criteria discussed in Corps of Engineers guidance was not considered to be applicable for use on this project. Discussions with HQUSACE Geotechnical personnel resulted in the use of lower minimum factors of safety for the design conditions presented in the Corps guidance. In addition, a new design condition, considering the use of residual soil shear strengths, and a minimum acceptable factor of safety for the new design condition, was developed for use on this project.

Other Considerations

Additional geotechnical design considerations included determining allowable channel side slopes for the English Coulee and Heartsville Coulee diversion channels, determining areas where erosion protection is required to minimize future erosion that could lead to failure of the levee foundation soils, and geotechnical design aspects of concrete floodwalls and other structures. Detailed discussions of the geology and geotechnical design aspects of this project are presented in Appendix B.

Future Work

Immediately following the preparation of the GRR, geotechnical instrumentation consisting of slope indicators and piezometers will be installed on a cross section just upstream of the existing water storage tank in Grand Forks. Several goals have been set for the instrumentation program.

- First, piezometric levels (i.e., positive pore pressure values) at the approximate location of the failure surface (hence, the slope indicators) will be determined. This

information is required to verify that pore pressures higher than those due to phreatic levels are not acting on the failure plane.

- Second, the location of the phreatic surface will be determined. This information is required to verify the location of phreatic surface used in the back-calculation process for determining the residual friction angle at this cross section.
- Third, the range of fluctuations of the phreatic surface with changes in river surface elevation and precipitation will be determined. This information is required to verify existing information regarding the fluctuation of the phreatic surface with season and to determine the effects of the fluctuations of the phreatic surface on the stability of the slope at this cross section.
- Fourth, the approximate zones of movement along the cross section will be determined. This information is required to more precisely back-calculate the residual friction angle at this cross section.

All of the information obtained will be use to fully and formally document a case history at this location. Based on this case history, several geotechnical alternatives for improving the stability of the slopes in critical design areas will be investigated. The geotechnical alternatives include passive drainage of the slope using gravel drains and pipes; reinforcement of the slope using drilled shafts, stone columns, deep mixing methods, and drilled lime stabilization; and a combination of any of the alternatives.

Other future geology and geotechnical efforts will consist of continued subsurface investigations (borings and laboratory testing), slope stability analysis work, and other related geotechnical design and geology work required to support preparation of future design memoranda and plans and specifications.

SOURCES OF CONSTRUCTION MATERIALS

Borrow Sites

The local sponsor is responsible for identifying sites to be used as borrow sources. Several potential borrow source locations have been identified to date. Geotechnical, archeological, and HTRW investigations have not been completed on these sites. These investigations will be completed as part of future studies to be completed for this project. Geotechnical parameters to be defined prior to approval of the site as a borrow source include: thickness of topsoil; presence or absence of saline or alkalai soils; thickness and suitability of alluvial/fluvial materials as levee fill materials; water table conditions; presence of water bearing seams; natural moisture content; and moisture-density relationships of the soils.

Satisfactory Borrow Materials

The alluvial/fluvial and upper depths of the Sherack Formation will most likely qualify as borrow materials. Factors affecting the acceptance of material as borrow include the depth to groundwater at the site, which could impact working conditions, and the presence or absence of saline or alkalai soils at the site. Brenna Formation materials are known to be difficult to excavate, remove from trucks, spread, and compact at the required density and moisture content. These soils are also quite deep, which again can impact excavation efficiencies. As a result, it is highly unlikely that Brenna Formation materials will be used as borrow materials.

Potential Borrow Sites

The most likely and readily available sources borrow material will be obtained from portions of the existing emergency levees in Grand Forks and East Grand Forks and the Corps of Engineers Lincoln Drive Levee in Grand Forks (see plate 166 of this report for more information). The emergency levees and the Lincoln Drive Levee will be removed as part of the project. The South End Drainway will continue to be constructed over the next several years. The excavated material from the drainway could be stockpiled and used for levee fill materials. This site has a potential to contain saline or alkali soils, based on discussions with a local excavation contractor. Geotechnical testing would be required to be completed on the soils at this site to determine the potential use as a borrow material.

The Grand Forks/East Grand Forks DPR identified three borrow sites. Geotechnical investigations were completed for these sites. An analysis of these sites indicates that one of the sites been developed into a new sub-division of Grand Forks and one of the sites is now a cemetery. These sites should no longer be considered for borrow. The third site is located in the approximate area east of Green's Nursery. Pending further geotechnical investigation to determine differences in land use and possible filling since 1954, this site may have some potential to be used as borrow. Several other potential borrow sites have been identified to date. These sites are discussed further in Appendix B.

Disposal Sites

The local sponsor is responsible for identifying sites to be used as disposal sites. At the present time, no sites have been identified for this purpose. These sites will be identified in future studies to be completed for this project. Geotechnical, archeological, and HTRW investigations will need to be completed at the identified sites to determine the potential to use the site as a disposal site.

Concrete Aggregate, Riprap, and Bedding

Sources for fine and coarse concrete aggregate, bedding, and riprap should be available locally. Most commercial aggregates in the Grand Forks/East Grand Forks vicinity are obtained from the beach ridges of Glacial lake Agassiz east and west of the Red River. Additional material may be available from field stone piles in farm fields. Most of the material consists of rounded, wave-washed boulders, cobbles, and sand. If large quantities of riprap size material are required, producers will need adequate lead time in order to stockpile material. Outside sources of quarried, angular, stone should also be available approximately 200 miles east of the proposed project in central and western Minnesota. Additional investigations will be necessary prior to plans and specifications to accurately quantify the amount of stone product available within a reasonable radius of the area.

RELIABILITY ASSESSMENT OF EXISTING LEVEES

The geotechnical rationale for assessing the reliability of the existing emergency levees for purposes of benefit determination is presented in Attachment 1 to Appendix B, which is a formal Reliability Analysis of Existing Levees (RAEL), as required by ETL 1110-2-328. The reliability of the existing levees is addressed considering the performance of the emergency levee system as a whole, based on flood fight experiences, and observations made during the 1997 flood. Formal slope stability and template method analyses were not incorporated into the RAEL; rather, a combination of reasonable closure lengths, reasonable closure heights, existing topography, flood fighting observations, and flood fighting rationale were utilized in the RAEL analysis.

HTRW SITE INVESTIGATIONS AND ASSOCIATED COSTS

General

Draft Phase I Environmental Site Assessments (ESAs) were completed along the levee and floodwall alignments in Grand Forks and in East Grand Forks for the Plan Comparison Letter Report. The ESAs were completed using an A/E Contractor. The purpose of the ESAs was to identify sites with potential environmental concerns associated with the construction of the flood control project features. A separate ESA was completed for each community. Construction activities that could encounter contaminated materials include stripping, grubbing, inspection trenches for levees, and foundation excavations for floodwalls and other structural project features requiring shallow foundations. A more detailed assessment of these sites is included in Attachment 2 to Appendix B.

Six sites in Grand Forks and two sites in East Grand Forks require Phase II Field Investigations to determine the contaminants of concern at each site and to confirm that the site poses a real environmental concern. Only one of the eight sites is considered to have the potential to encounter materials which meet the strict definition of HTRW materials, as defined in ER 1165-2-132; the remainder of the sites are considered to have a potential to encounter contaminated, non-HTRW materials. A more detailed assessment of the Phase II Field Investigation work is included in Attachment 2 to Appendix B.

Cost estimates were developed for investigation and remediation of the identified sites considered to be a potential environmental concerns. The costs include Phase II Field Investigation and Remedial Investigation (RI) Report costs, costs associated with the design of a Remedial Action (RA) for the site and preparation of plans and specifications for the RA, and costs associated with the RA for the site or the contaminated materials encountered during construction.

These costs could, based upon the results of ongoing Phase II Field Investigation activities, be determined to be a 100 percent non-Federal cost that is not included in the project costs. As such, the local sponsor(s) would be required to investigate and remediate the sites before the property is acquired for construction of the flood control project. However, since only ten percent of one of the sites is considered to have the potential to encounter materials which meet the strict definition of HTRW materials, it appears that the majority of the costs of investigating and remediating the sites

containing contaminated (non-HTRW) materials will be cost shared. This information will be available for inclusion in the Final GRR Report.

Grand Forks

In the Plan Comparison Letter Report, six sites with potential environmental concerns were identified in Grand Forks. These sites included: the Agsco pesticide release site near the proposed English Coulee levee crossing and pumping station; a potential uncontrolled fill site near the Strata Facility; an uncontrolled concrete rubble fill site at Red Dot Place and Alpha Avenue; two former Railroad Depots in downtown Grand Forks; and a former electric utility in downtown Grand Forks, which included coal gasification facilities. The total estimated cost for investigating and remediating these sites prior to or during construction of the flood control project was projected to be $1,637,948.

The Plan Comparison Letter Report also identified several additional sites in Grand Forks which may have potential environmental problems. However, additional information regarding these sites was determined to be needed before investigation and remediation costs could be attempted to be estimated. The identified sites included: a fill area south of the boat landing; a wastewater treatment facility on the RDO Foods property; potential releases at the RMI Facility; a release at a former City Services Facility located at 111 Gateway Drive; potential releases at a former Agsco facility near Gateway Drive; potential releases at the former Western Auto Parts building; uncontrolled fill sites yet to be determined; and residential/commercial fuel oil contaminated sites yet to be determined. Costs were determined based on an assumed number of “Uncontrolled Fill Sites Yet To Be Determined” and an assumed number of “Residential/Commercial Fuel Oil Contaminated Sites Not Yet Determined”.

Comments from MVD and MVS required that the scope of work for the ESAs be modified to include further research into the sites identified to have potential environmental concerns. As a result of the additional research, the following are no longer considered to be sites with potential environmental concerns: the fill area south of the boat landing; the wastewater treatment facility on the RDO Foods property; a release at a former City Services Facility located at 111 Gateway Drive; potential releases at a former Agsco facility near Gateway Drive; and potential releases at the former Western Auto Parts building. The number of sites assumed to be “uncontrolled fill sites yet to be determined” has been reduced to zero. It has been determined that the sites assumed to be “residential/commercial fuel oil contaminated sites” do not apply to the HTRW category. Details forming the basis of these conclusions are included in Attachment 2 to Appendix B.

The remaining sites with potential environmental concerns include: the English Coulee Pesticide Contamination site; three Uncontrolled Fill Sites (the RMI Facility, the Strata Facility, and the Concrete Rubble Site along the North End of Alpha Avenue); the Railroad Depot and Track Areas in downtown Grand Forks; and the Former Coal Gasification Site in downtown Grand Forks. The locations of these sites are presented on Plates B-2-1 though B-2-10 in Attachment 2 to Appendix B. The total updated estimated cost for investigating and remediating these sites prior to or during construction of the flood control project, based on the results of the additional Phase 1 ESA efforts required by MVD and MVS, is $1,221,000.

Although only a minor portion of the eight sites identified as having a potential to encounter HTRW materials are thought to meet the strict definition of HTRW materials, Phase II Field Investigations are ongoing for these sites to verify the nature of the materials at the sites. The costs for further investigating the sites, if required, and remediating the sites will be updated when these investigations are complete, which will be in time for the Final GRR Report.

East Grand Forks

In the Plan Comparison Letter Report, five sites with potential environmental concerns were identified in East Grand Forks. All of the sites were in the downtown and commercial areas of East Grand Forks. These sites include: potential release of dry cleaning fluids such as perchloroethylene at the former Star Troy Laundry Site at 113 through 119 Second Street North; potential petroleum product releases at the former Kenny's Auto Repair site; the Former East Grand Forks Dump site; potential PCB releases at the former Electrical Transformer Storage Yard; and a former petroleum release site at the 200 1st Avenue NW. The total estimated cost for investigating and remediating these sites prior to or during construction of the flood control project was projected to be $843,911.

The Plan Comparison Letter Report also identified several additional sites in East Grand Forks which may have potential environmental problems. However, additional information regarding these sites was determined to be needed before investigation and remediation costs could be attempted to be estimated. The identified sites included uncontrolled fill sites yet to be determined and residential/commercial fuel oil contaminated sites yet to be determined. Costs were determined based on an assumed number of “Uncontrolled Fill Sites Yet To Be Determined” and an assumed number of “Residential/Commercial Fuel Oil Contaminated Sites Not Yet Determined”.

Comments from MVD and MVS required that the scope of work for the ESAs be modified to include further research into the sites identified to have potential environmental concerns. As a result of the additional research, the following are no longer considered to be sites with potential environmental concerns: the potential petroleum product release site at Kenny’s Auto Service; the potential petroleum product release site at 200 1st Avenue NW; the potential PCB release site at the location of the former Electrical Transformer Storage Yard. The number of sites assumed to be “uncontrolled fill sites yet to be determined” has been reduced to zero. It has been determined that the sites assumed to be “residential/commercial fuel oil contaminated sites” do not apply to the HTRW category. Details forming the basis of these conclusions are included in Attachment 2 to Appendix B.

The remaining sites with potential environmental concerns include the former Star-Troy Laundry Site and the Former East Grand Forks Dump Site. The locations of these sites are presented on Plates B-2-11 and B-2-12 in Attachment 2 to Appendix B. The total estimated cost for investigating and remediating these sites prior to or during construction of the flood control project, based on the results of the additional Phase 1 ESA efforts required by MVD and MVS, is $1,852,000.

Although only a minor portion of the eight sites identified as having a potential to encounter HTRW materials are thought to meet the strict definition of HTRW materials, Phase II Field Investigations are ongoing for these sites to verify the nature of the materials at the sites. The costs for further investigating the sites, if required, and remediating the sites will be updated when these investigations are complete, which will be in time for the Final GRR Report.

Summary

The estimated cost for investigating and remediating these sites prior to or during construction of the flood control project is $1,221,000 for Grand Forks and $1,852,000 for East Grand Forks, for a total cost of $3,073,000. At the present, only 10 percent of the costs associated with one of the sites in Grand Forks, amounting to $14,000, has been determined to meet the strict definition of HTRW materials, and is not available for cost sharing. The total cost shared HTRW cost is $3,059,000 and the total non-cost shared HTRW cost is $14,000. These values will be updated

Economic Social Financial

Since the devastating flood of 1997, the communities of East Grand Forks and Grand Forks have pulled together to plan for the area's future. They have clearly identified permanent flood protection as a priority for the entire community, and recognize that it is important for future development that the level of protection in the area be both high and uniform throughout. As a result, protecting parts of the community incrementally at different levels of protection is not implementable. This fact, when combined with the hydraulic unity of the study area (see Hydraulic Findings Sections for additional details about hydraulic unity), makes incremental justification or optimization of the project features unnecessary and inappropriate.

Using the structure inventory information and depreciated replacement values of structures damaged by flooding, a generalized depth-damage relationship was used to define the magnitude of expected damages for varying flood events. The reliability of existing flood reduction structures was evaluated from a geotechnical perspective and was incorporated into the depth-damage model. These damages were then annualized to define the without-project/existing condition average annual flood damages (see the Economic-Social-Financial Appendix for detailed discussion of without project flood damages, with project flood damage reduction benefits, and residual damages.

ECONOMICS

There are a number of technical issues involved in preparing the economic analysis for the letter report. Among these are: 1) updating of depth-damage curves for residential and commercial structures and contents; 2) documentation of flood damages in other economic impact categories; 3) documentation of other losses and costs attributable to the April 1997 flood; and 4) applying updated flood frequency data and using historic damage data, where available, to develop estimates of average annual benefits under future "with-project" conditions across the range of acceptable NED benefit categories.

A team of Corps economists worked in the field at Grand Forks and East Grand Forks, during October 1997, conducting depth-damage surveys of residential and commercial properties. More than 400 residential surveys were completed, based on randomly sampled addresses drawn from four flood zone strata in the two cities. More than 80 commercial surveys were completed based on representative sampling from different types of business establishments. The field team also collected damage and cost data from other types of flood impacts.

Results from the depth-damage surveys were analyzed and regression equations were developed for residential structures and contents reflecting updated depth-damage relationships. Damage information from other sources was reviewed and included: FEMA inspection reports on buildings damages; Small Business Administration (SBA) loans to cover residential and commercial structure and content losses; flood insurance claims payouts; depth-damage curves in use elsewhere in the Corps; EQE International consultant report and critique on St. Paul District's economic data and models; and Institute for Water Resources (IWR) work on updating depth-damage curves.

For commercial structures and contents, the depth-damage survey data collected in October 1997 were compared, for a number of individual business structure types, with the depth-damage relationships for these structures previously used at Grand Forks and East Grand Forks. The differences in damage estimates were determined. Survey results were also compared with depth-damage curves for commercial structures and contents used elsewhere in the Corps. Previous estimates of commercial structure and content damages were then revised, using the October 1997 survey results.

Damages and costs associated with the April 1997 flood were also obtained or otherwise examined in the following categories: household costs involving temporary relocations during the flooding and cleanup after the flooding, from the October 1997 survey; public building and content damages, from the October 1997 survey and other sources; industrial property damage; infrastructure damages; vehicle damage; emergency response costs for both public sector and private relief agencies; and transportation disruption costs.

Other potential National Economic Development benefits associated with future with-project conditions that are at least preliminarily discussed include: flood insurance administrative cost savings; recreation benefits associated with the possibility of a "greenway" along both sides of the river inside the levees; location and intensification benefits; and advance replacement benefits.

In January 1998, the above mentioned economic analysis was completed as the initial optimization effort to identify the NED plan and to quantify the benefits and costs associated with the alternatives compared in the final screening. This analysis showed the effects of the total first costs, Interest During Construction (IDC), and operations and maintenance costs in calculation of the costs for each plan. The average annual benefits associated with each plan evaluated were also calculated -- this is a total of the damage reductions, future costs avoided, and redevelopment benefits.

It is conservative to assume that flood damages begin at East Grand Forks/Grand Forks when the Red and Red Lake Rivers rise to the point where one or more residential structures begins to be directly flooded. This is conservative because direct flooding causes damages usually even before direct basement flooding (e.g., floodwaters will need to be pumped at

multiple entry points due to street manholes and porous clay sewer lines opening which provide entry into the interconnected sewer system for movement of floodwaters prior to direct basement flooding). When direct flooding begins, floodwaters flow through the interconnected sanitary sewers and indirectly damage additional structures. Then, as the floodwater stage gets higher, a greater number of structures are directly flooded. This provides more floodwater entry points into the sanitary sewer system and allows greater indirect damages to occur.

A number of factors contribute to high indirect flood damages. These are listed below:

- Grand Forks and East Grand Forks both have an interconnected sanitary sewer system with many entry points (basement drains and along streets at manholes).
- The duration of flooding allows the floodwaters to back up throughout the sanitary sewer system.
- Almost all structures (residential, commercial, industrial, and public) have basements with extensive utilities and contain difficult to move, flood damageable, and costly equipment/belongings (e.g., a typical residential basement contains a furnace = $2,500, a water heater = $300, a washer and dryer = $600, and furniture/carpets /wall coverings/etc. = $1,000 to $4,000).

SOCIAL / FINANCIAL

The evaluation and assessment of social, institutional, and local economic effects is developed in two steps. The first involves documentation of the deprivations suffered by the cities of Grand Forks and East Grand Forks and their residents as the result of the April 1997 flood (for the purpose of explaining what social and community impacts can be prevented or avoided if a permanent project were in place to protect against a similar flood in the future). The second involves a comparison of most likely future conditions with respect to social and local economic effects in the two communities, depending on whether a permanent flood damage reduction project is constructed.

A critical need is to develop adequate information on social and local economic effects to fully understand the implications for recovery (or lack thereof) in the two communities if a permanent project is NOT constructed. This constitutes the base condition for establishing and comparing social and local economic effects of the "with-project" alternative(s).

Social and local economic effects are NOT included in the calculation of the project benefit-cost ratio, where National Economic Development (NED) benefits are documented to determine the Federal interest in a flood damage reduction project. But in this project area, given the experience of the April 1997 flood, it is essential that information concerning social and local economic effects associated with future "without-project" and "with-project" alternatives be fully considered by decision-makers.

The delineation of the future 100-year floodplain in the two communities, while not available at this time, is a very important factor to consider. Hydrologic and hydraulic engineering analysis, incorporating the 1996 and 1997 floods, has produced an updated flood frequency analysis for the Red River at Grand Forks. The future 100-year floodplain is likely to be greatly expanded, given that the flood stage for the 1-percent chance flood event (so called

"100-year event") is expected to increase on the order of 1.5 feet in an area that is very flat. A greatly expanded area within the two cities may face restrictions in future residential and commercial redevelopment, or intensification of development, unless it includes actions such as floodproofing or elevation of structures that would comply with floodplain regulations under the future "without project" condition. This has very significant implications for social and local economic effects in considering alternative future without and with-project conditions in the two communities.

The evaluative tool used to assess likely social and local economic effects in the EIS report is the "Impact Matrix Table" that is part of an environmental effects evaluation and reporting process. It includes ten parameters covering social effects and ten parameters covering local economic effects. These parameters help to structure research needs, organize information and data, and identify issues of importance in considering the effects of project implementation.

The firm Gulf Engineers & Consultants, Baton Rouge, Louisiana, was engaged in December 1997 to collect information and data to document the social, institutional, and local economic effects of the April 1997 flood for the letter report. The firm was also requested, within the limited time available, to prepare an initial assessment of social and economic effects by completing three impact matrix tables, with supporting explanations, for these future conditions: 1) without-project; 2) with-project, in-town levee plan; and 3) with-project, split-flow diversion plan. A report, describing significant social and local economic issues and effects, along with discussion and comparison of alternative future conditions, was prepared and will be used to complete socio-economic assessment portions of the GRR/EIS.

Cost Engineering

Cost engineering for the screening and NED optimization efforts of this study were accomplished during the final screening of alternatives phase of plan formulation and were documented in the Plan Comparison Letter Report, February 1998. For more detailed information, the comparative/preliminary cost summaries for the 50-year, 100-year, 210-year (1997 flood), and out-of-town features of split-flow diversion plans are included in the cost engineering appendix of the Supplemental Report. Those comparative cost evaluations and associated economic benefits evaluations showed that the 210-year (1997 flood) level of flood protection was the most cost-effective alternative. Those cost estimates were of a level of detail to allow selection of a NED plan and of sufficient detail to allow the feasibility of the plans evaluated to be determined. Those final screening cost estimates were prepared by Corps and SEH cost engineers and they established the NED plan in its initial identification. However, a detailed baseline cost estimate, referred to in the Corps of Engineers as MCACES cost estimates, for the recommended plan was not finalized until July 1998 and it is presented in this GRR document.

After initial identification of the recommended plan in February 1998, detailed design and real estate acquisition efforts were undertaken and completed that quantified the recommended plan. This revised features and lands quantity calculation is needed in order to complete a quality baseline cost estimate and was more detailed than had been accomplished previously. A quantified listing of the major features of the recommended plan follows for each city and reach:

Major Grand Forks Area Features Include:

(See plates 4 through 73)

- 408 acres of fee title lands and 264 acres of temporary easements of real estate acquisition for unimproved and city owned properties (acreage does not include improved properties).

206 single family homes (some are historically significant), 24 apartments, 11 condominiums, 6 businesses, RDO Food water plant, and portions of the GF city water

- 7.2 miles of in-town levees (ranging from 8 to 22 feet in height and having a 10-foot- wide levee top with 1 vertical on 3 horizontal side slopes)

- 1.0 miles of in-town road raise levees

- 1.8 miles of tieback levees

- 2.3 miles of road raise tieback levees

- 1.1 mile of floodwalls

- 0.5 mile of mechanically stabilized earth wall/levee

- 7 road raises that cross the levee alignment

- 7 road stoplog closure structures

- 1 road earth closure

- 2 railroad stoplog closure structures

- 0.6 miles of new streets

- 9 pump stations

- 22 gated outlets

- 4.0 miles of new English Coulee diversion channel (ranging from 5 to 12 feet in depth and having a 30- to 60-foot bottom width with 1 vertical on 5 horizontal side slopes)

- 4.5 miles of existing English Coulee diversion channel modifications (widening bottom width to 80 feet grading 1 vertical on 5 horizontal side slopes and replacing existing drop structures near outlet to the Red River.

Major East Grand Forks (North) Area Features Include:

(See plates 74 through 126)

- 177 acres of fee title and 49 acres of temporary easement real estate acquisition for unimproved and city owned properties (acreage does not include improved properties)

- 16 single family homes and 60 apartments

- 10 businesses

- 10.1 miles of levees (ranging from 7.5 to 23 feet in height and having a 10-foot top width with 1 vertical on 3 horizontal side slopes)
- 1.2 miles of road raise levees
- 0.2 mile of floodwalls
- 0.1 mile of MSE wall/levee
- 11 road raises which cross the levee alignment
- 6 road stoplog closure structures
- 2 railroad stoplog closure structures
- 5 pump stations
- 9 gated outlets

Major East Grand Forks (Point Area/South) Area Features Include:

(See plates 127 through 164)

- 153 acres of fee title and 37 acres of temporary easement real estate acquisition for unimproved and city owned properties (acreage does not include improved properties).
- 30 single family homes
- 6.0 miles of levees (ranging from 9.5 to 21 feet in height and having a 10-foot top width with 1 vertical on 3 horizontal side slopes)
- 0.8 mile of floodwalls
- 8 road raises that cross the levee alignment
- 2 road stoplog closure structure
- 0.2 mile of new streets
- 2 pump stations
- 10 gated outlets
- 1.2 miles of new Hartsville Coulee diversion channel (ranging from 18 to 20 feet in depth and having a 10 foot bottom width with 1 vertical on 7 horizontal side slopes).
- 3 drop structures near outlet to the Red River

The detailed MCACES cost estimate for the recommended 210-year features is presented in the following tables. They show the breakout of costs for the total project, the north end portion of East Grand Forks, the Point (South end) portion of East Grand Forks, and the Grand Forks portion of costs by subaccounts. All costs are shown in December 1997 dollars.

Grand Forks Community Cost Breakouts

PROJECT COST SUMMARY SHEET - SUBTOTAL: GRAND FORKS, ND
East Grand Forks & Grand Forks Flood Control - General Reevaluation Report

Red River of the North

PREPARED BY: Mike Osterby, CEMVP-PE

Project: East Grand Forks and Grand Forks Flood Control
Location: Grand Forks, North Dakota

REVIEWED and APPROVED BY: Michael S. Dahlquist
Chief, Cost Engineering and Specifications Section

Date: 03-Aug-98

No.	Description	Total Estimated Amount	Contingency Amount	Contingency Percent	Estimated Amount Plus Contingency	Index Factor To 10/98	Indexed Cost To 10/98	Midpoint Of Feature Year	Index To Midpoint Factor	Fully Funded Amount	Fully Funded Contingency	Fully Funded Amount Plus Contingency
Grand Forks Flood Control-Grand Forks, ND												
.01	Lands and Damages	$62,720,000	$12,544,000	20%	$75,264,000	0.015	$76,393,000	Oct-2000	0.053	$67,035,000	$13,407,000	$80,442,000
.02	Relocations	28,133,000	8,721,000	31%	36,854,000	0.015	$37,407,000	Oct-2002	0.108	$31,639,000	$9,808,000	$41,447,000
.09	Channels and Canals	11,925,000	2,876,000	24%	14,801,000	0.015	$15,023,000	Oct-2002	0.108	$13,411,000	$3,234,000	$16,645,000
.11	Levees and Floodwalls	24,949,000	7,280,000	29%	32,229,000	0.015	$32,712,000	Oct-2002	0.108	$28,058,000	$8,187,000	$36,245,000
.13	Pumping Plant	9,219,000	2,305,000	25%	11,524,000	0.015	$11,697,000	Oct-2002	0.108	$10,368,000	$2,592,000	$12,960,000
.30	Planning, Engineering and Design	12,514,000	1,517,000	12%	14,031,000	0.027	$14,410,000	Oct-2000	0.080	$13,880,000	$1,683,000	$15,563,000
.31	Construction Management	4,046,000	607,000	15%	4,653,000	0.027	$4,779,000	Oct-2002	0.168	$4,853,000	$728,000	$5,581,000
.32	HTRW	799,000	551,000	69%	1,350,000	0.015	$1,370,000	Oct-2002	0.108	$899,000	$620,000	$1,519,000
	Estimated Project Cost	$154,305,000	$36,401,000	24%	$190,706,000		$193,791,000			$170,143,000	$40,259,000	$210,402,000

Other estimated costs not included in totals above.

.14	Recreation Facilities*	$3,019,000	$755,000	25%	$3,774,000	0.015	$3,831,000	Oct-2002	0.108	$3,395,000	$849,000	$4,244,000
.18	Cultural Resource Preservation**	$660,000	$132,000	20%	$792,000	0.015	$804,000	Oct-2002	0.108	$742,000	$148,000	$890,000

* Recreation is not part of the basic flood protection project and must be incrementally justified.
** Cultural Resource Preservation is not to be included in the B/C ratio.

Costs are based on December 1997 unit pricing.

Note: Contingencies are not applied to sunk cost in Account 30.

North End of East Grand Forks Cost Breakouts

PROJECT COST SUMMARY SHEET - SUBTOTAL: EAST GRAND FORKS, MN
East Grand Forks & Grand Forks Flood Control - General Reevaluation Report

Red River of the North

PREPARED BY: Mike Osterby, CEMVP-PE

Project: East Grand Forks and Grand Forks Flood Control
Location: East Grand Forks, Minnesota

REVIEWED and APPROVED BY: Michael S. Dahlquist
Chief, Cost Engineering and Specifications Section

Date: 03-Aug-98

No.	Description	Estimated Amount	Contingency Amount	Contingency Percent	Estimated Amount Plus Contingency	Index Factor To 10/98	Indexed Cost To 10/98	Midpoint Of Feature Year	Index To Midpoint Factor	Fully Funded Amount	Fully Funded Contingency	Fully Funded Amount Plus Contingency
East Grand Forks Flood Control-East Grand Forks, MN												
.01	Lands and Damages	$15,495,000	$3,099,000	20%	$18,594,000	0.015	$18,873,000	Oct-2000	0.053	$16,561,000	$3,312,000	$19,873,000
.02	Relocations	$5,552,000	$1,807,000	33%	$7,359,000	0.015	$7,469,000	Oct-2002	0.108	$6,244,000	$2,032,000	$8,276,000
.09	Channels and Canals	$3,323,000	$954,000	29%	$4,277,000	0.015	$4,341,000	Oct-2002	0.108	$3,737,000	$1,073,000	$4,810,000
.11	Levees and Floodwalls	$12,574,000	$2,831,000	23%	$15,405,000	0.015	$15,636,000	Oct-2002	0.108	$14,141,000	$3,184,000	$17,325,000
.13	Pumping Plant	$6,476,000	$1,619,000	25%	$8,095,000	0.015	$8,216,000	Oct-2002	0.108	$7,283,000	$1,821,000	$9,104,000
.30	Planning, Engineering and Design	$5,715,000	$737,000	13%	$6,452,000	0.027	$6,626,000	Oct-2000	0.080	$6,339,000	$817,000	$7,156,000
.31	Construction Management	$1,966,000	$295,000	15%	$2,261,000	0.027	$2,322,000	Oct-2002	0.168	$2,358,000	$354,000	$2,712,000
.32	HTRW	$297,000	$207,000	70%	$504,000	0.015	$512,000	Oct-2002	0.108	$334,000	$233,000	$567,000
	Estimated Project Cost	$51,398,000	$11,549,000	22%	$62,947,000		$63,995,000			$56,997,000	$12,826,000	$69,823,000

Other estimated costs not included in totals above.

.14	Recreation Facilities*	$1,809,000	$452,000	25%	$2,261,000	0.015	$2,295,000	Oct-2002	0.108	$2,034,000	$508,000	$2,542,000
.18	Cultural Resource Preservation**	$95,000	$19,000	20%	$114,000	0.015	$116,000	Oct-2002	0.108	$107,000	$21,000	$128,000

* Recreation is not part of the basic flood protection project and must be incrementally justified.
** Cultural Resource Preservation is not to be included in the B/C ratio.

Costs are based on December 1997 unit pricing.

Note: Contingencies are not applied to sunk cost in Account 30.

South End (Point Area) of East Grand Forks Cost Breakouts

PROJECT COST SUMMARY SHEET - SUBTOTAL: THE POINT AREA in EAST GRAND FORKS, MN
East Grand Forks & Grand Forks Flood Control - General Reevaluation Report

Red River of the North

PREPARED BY: Mike Osterby, CEMVP-PE

Project: East Grand Forks and Grand Forks Flood Control
Location: The Point Area in East Grand Forks, MN

REVIEWED and APPROVED BY: Michael S. Dahlquist
Chief, Cost Engineering and Specifications Section

Date: 03-Aug-98

No.	Description	Estimated Amount	Contingency Amount	Contingency Percent	Estimated Amount Plus Contingency	Index Factor To 10/98	Indexed Cost To 10/98	Midpoint Of Feature Year	Index To Midpoint Factor	Fully Funded Amount	Fully Funded Contingency	Fully Funded Amount Plus Contingency
East Grand Forks Flood Control- The Point in East Grand Forks, MN												
.01	Lands and Damages	$11,715,000	$2,343,000	20%	$14,058,000	0.015	$14,269,000	Oct-2000	0.053	$12,521,000	$2,504,000	$15,025,00
.02	Relocations	$2,139,000	$799,000	37%	$2,938,000	0.015	$2,982,000	Oct-2002	0.108	$2,406,000	$899,000	$3,305,00
.09	Channels and Canals	$6,433,000	$1,319,000	21%	$7,752,000	0.015	$7,868,000	Oct-2002	0.108	$7,235,000	$1,483,000	$8,718,00
.11	Levees and Floodwalls	$12,484,000	$3,353,000	27%	$15,837,000	0.015	$16,075,000	Oct-2002	0.108	$14,040,000	$3,771,000	$17,811,00
.13	Pumping Plant	$1,558,000	$390,000	25%	$1,948,000	0.015	$1,977,000	Oct-2002	0.108	$1,752,000	$439,000	$2,191,00
.30	Planning, Engineering and Design	$2,866,000	$310,000	11%	$3,176,000	0.027	$3,262,000	Oct-2000	0.080	$3,179,000	$344,000	$3,523,00
.31	Construction Management	$1,737,000	$261,000	15%	$1,998,000	0.027	$2,052,000	Oct-2002	0.168	$2,084,000	$313,000	$2,397,00
.32	HTRW	$0	$0		$0	0.015	$0	Oct-2002	0.108	$0	$0	$
	Estimated Project Cost	$38,932,000	$8,775,000	23%	$47,707,000		$48,485,000			$43,217,000	$9,753,000	$52,970,00

Other estimated costs not included in totals above.

.14	Recreation Facilities*	$1,181,000	$295,000	25%	$1,476,000	0.015	$1,498,000	Oct-2002	0.108	$1,328,000	$332,000	$1,660,00
.18	Cultural Resource Preservation**	$58,000	$12,000	21%	$70,000	0.015	$71,000	Oct-2002	0.108	$65,000	$13,000	$78,00

* Recreation is not part of the basic flood protection project and must be incrementally justified.
** Cultural Resource Preservation is not to be included in the B/C ratio.

Costs are based on December 1997 unit pricing.

Note: Contingencies are not applied to sunk cost in Account 30.

Total Community Cost Breakouts

TOTAL PROJECT COST SUMMARY SHEET
East Grand Forks & Grand Forks Flood Control - General Reevaluation Report

Red River of the North

PREPARED BY: Mike Osterby, CEMVP-PE

Project: East Grand Forks and Grand Forks Flood Control
Location: Grand Forks, North Dakota and East Grand Forks, Minnesota

REVIEWED and APPROVED BY: Michael S. Dahlquist
Chief, Cost Engineering and Specifications Section

Date: 03-Aug-98

No.	Description	Estimated Amount	Contingency Amount	Contingency Percent	Estimated Amount Plus Contingency	Index Factor To 10/98	Indexed Cost To 10/98	Midpoint Of Feature Year	Index To Midpoint Factor	Fully Funded Amount	Fully Funded Contingency	Fully Funded Amount Plus Contingency
Combined Grand Forks / East Grand Forks Flood Control												
.01	Lands and Damages	$89,930,000	$17,986,000	20%	$107,916,000	0.015	$109,535,000	Oct-2000	0.053	$96,117,000	$19,223,000	$115,340,000
.02	Relocations	$35,824,000	$11,327,000	32%	$47,151,000	0.015	$47,858,000	Oct-2002	0.108	$40,288,000	$12,739,000	$53,027,000
.09	Channels and Canals	$21,681,000	$5,149,000	24%	$26,830,000	0.015	$27,232,000	Oct-2002	0.108	$24,383,000	$5,791,000	$30,174,000
.11	Levees and Floodwalls	$50,007,000	$13,464,000	27%	$63,471,000	0.015	$64,423,000	Oct-2002	0.108	$56,239,000	$15,142,000	$71,381,000
.13	Pumping Plant	$17,253,000	$4,314,000	25%	$21,567,000	0.015	$21,891,000	Oct-2002	0.108	$19,403,000	$4,852,000	$24,255,000
.30	Planning, Engineering and Design	$21,095,000	$2,564,000	12%	$23,659,000	0.027	$24,298,000	Oct-2000	0.080	$23,398,000	$2,844,000	$26,242,000
.31	Construction Management	$7,749,000	$1,163,000	15%	$8,912,000	0.027	$9,153,000	Oct-2002	0.168	$9,295,000	$1,395,000	$10,690,000
.32	HTRW	$1,096,000	$758,000	69%	$1,854,000	0.015	$1,882,000	Oct-2002	0.108	$1,233,000	$852,000	$2,085,000
	Total Estimated Project Cost	$244,635,000	$56,725,000	23%	$301,360,000		$306,272,000			$270,356,000	$62,838,000	$333,194,000

Other estimated costs not included in totals above.

.14	Recreation Facilities*	$6,009,000	$1,502,000	25%	$7,511,000	0.015	$7,624,000	Oct-2002	0.108	$6,758,000	$1,689,000	$8,447,000
.18	Cultural Resource Preservation**	$813,000	$163,000	20%	$976,000	0.015	$991,000	Oct-2002	0.108	$914,000	$183,000	$1,097,000

* Recreation is not part of the basic flood protection project and must be incrementally justified.
** Cultural Resource Preservation is not to be included in the B/C ratio.

Costs are based on December 1997 unit pricing.

Note: Contingencies are not applied to sunk cost in Account 30.

Environmental/Natural Resources

ENVIRONMENTAL RESOURCES

This section summarizes the evaluation contained in the Environmental Impact Statement (EIS) which may be found in a later section of this document. The EIS considers the potential effects of alternatives on the existing conditions of the area, predicting the future conditions that may occur with the project in place. When compared to future conditions without the construction of the project, the effects of project construction and operation may be determined.

The scope of the EIS was defined with the assistance of public input and considered the potential of the project to affect various resources including:

1. Natural resources including: fishery, wildlife, vegetation, wetlands, and riparian areas;
2. Cultural resources, both historic and archaeological;
3. Water quality, river sediment contamination, groundwater, erosion, and sedimentation; and
4. Social and economic resources, including the loss of established neighborhoods.

NATURAL RESOURCES

Existing Setting

The communities of East Grand Forks, Minnesota and Grand Forks, North Dakota, are located on the Red River of the North in the glacial lakebed of Lake Agassiz. The soil is glacial till and the climate is continental with moderate rainfall and temperature extremes. The area is part of the tall grass prairie ecosystem and on the eastern edge of the prairie pothole (wetland) area.

The Red River of the North drains eastern North Dakota and western Minnesota. The Red Lake River is a major tributary to the Red River of the North that enters the river at East Grand Forks. The rivers have similar water quality and fisheries which provide habitat for typical species including channel catfish, walleye and northern pike, among others.

The riparian corridor through the two cities is narrow and bounded by emergency levees. Vegetation is limited and not continuous and provides habitat for species typical of disturbed and urban environments.

Environmental Effects on Natural Resources

The proposed plan would result in the removal of the existing emergency levees. They would be replaced with new levees that would provide protection against floods equal to

the flood of 1997. The area between the new levees would double in size and would be cleared of structures and associated infrastructure. It would be allowed, for the most part, to revert to natural vegetation. This would increase its habitat value substantially because it would be less disturbed and less patchy, eventually forming a riparian corridor of native vegetation through the urban area. The vegetation would provide greater habitat diversity for more species. Understory plants would filter runoff and improve water quality in the rivers. Overhead vegetation would provide some shade and improved cover for fish.

There would be two diversions at English Coulee and Hartsville Coulee. These watercourses are intermittent runoff streams that collect overland flow. Since the diversion would only function during flood periods, the diversion would be expected to have minimal effect on the habitat downstream of the diversions. The plan would include the placement of riprap near the Riverside Dam and the confluence of the two rivers. This would reduce bank erosion and sedimentation in the river, stabilize conditions at and near the dam, and provide some solid substrate for the growth of fish food organisms. No excavation of the riverbed would take place. No contaminated material would be disturbed or exposed.

The project would have no effect on groundwater and no wetlands would be disturbed by construction. Rock would be obtained from farmers' field piles or quarries. The emergency levees would provide much of the material for the construction of new levees, limiting the need for excavating new borrow sites. Except for demolition debris, there would be only limited material for disposal.

In summary, the benefits of the establishment of a 2,000-acre riparian corridor or greenway through the urban area would provide an increase in habitat and improvement in water quality that would more than offset the minimal adverse effects of the construction and operation of the flood reduction project.

Cultural and Historic Resources

GENERAL

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (Public Law 89-665), as amended, requires that a Federal agency take into account the effect of an undertaking on properties listed on or determined eligible to the National Register of Historic Places and also afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to the undertaking. The implementing regulation for Section 106 is the Advisory Council's regulation for the Protection of Historic and Cultural Properties (36 CFR Part 800). Section 110 of the NHPA requires a Federal agency to preserve and protect historic properties in the area of a Federal undertaking to the extent feasible and, where not feasible, to ensure that the appropriate level of documentation is completed prior to alteration, relocation, or demolition. The National Environmental Policy Act (NEPA) (Public Law 91-190) requires that the Federal agency prepare an environmental assessment or environmental impact statement (EIS) as part of the planning and decision-making process. Historic and other cultural resources are to be taken into consideration as part of the EIS process.

The Cities of Grand Forks and East Grand Forks specified that their flood protection system had to be permanent, had to provide a 210-year level of protection (1997 flood plus 3 feet of freeboard), and had to be economically, environmentally, and socially acceptable. Geotechnical and soil stability were the main factors determining how close to or far from the river the levees could be built. A goal of keeping levee heights at 10 feet or less was established to lessen the visual impacts of the flood protection features; however, at a few locations, notably along Belmont Road, a higher levee is necessary in order to save more residences.

Prior to February 1998, the Corps was looking at two flood protection alternatives for East Grand Forks and Grand Forks. The levees only alternative consisted of a system of levees which would provide protection for an event equivalent to the 1997 flood (210-year level of protection). The diversion alternative consisted of a combination of in-town levees providing a 100-year level of protection plus a diversion channel for the Red River to handle any additional flows up to the 1997 flood equivalent. The Plan Comparison Report provided by the Corps to help the Cities make a decision on which flood protection alternative to pursue contained cultural resources information for the levees only alternative and the levees portion of the diversion alternative provided by the Corps and cultural resources information for the Red River diversion channel portion of the diversion alternative provided by IMA Consulting, the archeological subcontractor for Short Elliott Hendrickson (ref. Florin et al., 1998, *Grand Forks/East Grand Forks General Reevaluation: Cultural Resources*, IMAC, Minneapolis). The close proximity of the levee alignments for the two alternatives meant that the potential effects to cultural resources in town would have been the same for both alternatives. However, the diversion alternative would have had added impacts to cultural resources over the levees only alternative, particularly where the diversion channel exited and re-entered the Red River. Primarily for economic reasons, the Cities elected to go with the levees only alternative.

Once the general levee alignment was determined for each city, the Corps took a detailed look at geotechnical and soil stability factors for each segment of the alignment to determine if the proposed levee could be moved farther riverward in order to preserve additional buildings and city infrastructure which would have otherwise been lost. Some adjustments to the location of the proposed flood protection alignment were also made possible by substituting the more expensive mechanically stabilized earthen walls (MSE walls) and floodwalls for segments of levee.

Specific refinements to the alignments involving historic properties included substitution of a floodwall for the levee along North 3rd Street from Lewis Boulevard to just past 2nd Avenue North in order to save houses along that street and to preserve historic buildings in downtown Grand Forks, including the former Northern Pacific Railroad Depot and Freight House. In the case of St. Anne's Guest Home on Lewis Boulevard just south of Highway 2, a combination of shifting the levee alignment slightly landward and floodproofing the lower floors was selected so that this National Register listed building can be preserved in place.

In the Riverside Park area north of downtown Grand Forks, part of the levee alignment between Park and Seward Avenues could be shifted riverward to the east side of Lewis Boulevard. This means that additional historic houses in the Riverside Park Historic District and part of the National Register listed granitoid pavement of Lewis Boulevard will

now be protected. Levee size and geotechnical and soil stability do not allow for relocation of the proposed levee alignment farther riverward in this area.

In the Reeves Drive area south of downtown Grand Forks, a number of options have been and are being looked at to minimize impacts to this historic neighborhood, which is part of the East Side Residential Historic District. The most viable option consists of substituting a floodwall for the levee and moving those houses which still cannot be avoided to the front of their lots. Channel modification, involving shifting the Red River channel eastward and building up the area riverward of these houses so that they can remain in place with a levee or floodwall built on the filled area, was also looked at as an option, but it is infeasible for legal and environmental reasons. Additional information on the Reeves Drive area is included in the Areas of Controversy section of the EIS.

Another area of controversy is the Corps proposal to remove the National Register eligible former Northern Pacific Railroad Bridge that spans the Red River just north of Demers Avenue. This center-pivot railroad swing bridge was converted to a stationary pedestrian bridge when the City of Grand Forks acquired it in 1983. The Corps is proposing to remove this bridge and its large central stone pier and two wooden side piers in order to reduce the obstructions to flow in the river. Removal of the bridge means that the water in the Red River upstream of its location would be up to 6 inches lower than with the bridge present. This in turn means that the proposed levees and floodwalls upstream would not have to be built as high as if the bridge remains. The North Dakota State Historic Preservation Office (SHPO) and the Grand Forks Historic Preservation Commission prefer that this historic bridge remain in place. Additional information on the proposed bridge removal is included in the Areas of Controversy section of the EIS.

PROGRAMMATIC AGREEMENT

Because of the multi-State nature of the proposed flood protection project and because the effects on historic properties in the project area cannot be fully determined prior to its authorization, the St. Paul District, U.S. Army Corps of Engineers (Corps) is negotiating a Programmatic Agreement (PA) with the North Dakota State Historic Preservation Officer (NDSHPO), the Minnesota State Historic Preservation Officer (MNSHPO), and the Washington office of the Advisory Council on Historic Preservation (Advisory Council). The Cities of East Grand Forks and Grand Forks, as local sponsors, are concurring parties to this agreement. The Grand Forks Historic Preservation Commission is also a concurring party. The Programmatic Agreement, a copy of which is included with the EIS, stipulates what the Corps will have to do in order to be in compliance with Sections 106 and 110 of the NHPA and with NEPA.

Stipulations of the PA cover (1) the identification of archeological, historical, and architectural sites in the project area; (2) the National Register eligibility evaluation of these sites, buildings, and structures; (3) the procedures to be followed if human burials are found in the project area; (4) the identification of traditional cultural properties in the project area; (5) the identification of new historic districts, multiple resource areas, historic landscapes and viewsheds in the project area; (6) guidelines to be followed in the treatment of historic properties in the project's area of potential effect; (7) mitigation of adverse effects, both individual and cumulative, to historic properties; and (8) provisions for public and tribal involvement in the Section 106 process.

INVENTORY AND EVALUATION OF HISTORIC PROPERTIES

A St. Paul District Corps archeologist conducted a literature and records search at the State Historic Preservation Office of the Minnesota Historical Society in St. Paul in October 1997, and at the Archaeology and Historic Preservation Division of the State Historical Society of North Dakota in Bismarck in December 1997. The purpose of the literature and records search was to determine the extent of previous archeological surveys and architectural inventories in the vicinity of Grand Forks and East Grand Forks and to compile a list of prehistoric archeological, historic archeological, and architectural sites and site leads for the potential project area locations in Grand Forks County, North Dakota, and Polk County, Minnesota. In addition, the Cities of Grand Forks and East Grand Forks provided the Corps with information on the year of construction of the various buildings and structures in the project area and information on which properties were acquired under their respective 1997 flood voluntary buyout programs.

A summary of the prehistory and history of the Grand Forks and East Grand Forks portion of the Red River Valley, a summary of previous cultural resources investigations for the project vicinity, and an overview of the sites, historic districts and multiple resource areas in the project area are included in the Affected Environment section of the EIS. The Environmental Effects section of the EIS discusses the effects of the project on National Register listed and eligible properties and on the two historic districts and downtown multiple resource area in the City of Grand Forks, as well as cumulative effects on the historic resources of both Grand Forks and East Grand Forks.

Detailed inventory information for the buildings, standing structures, and archeological sites located in and riverward of the proposed levee and floodwall alignments for both East Grand Forks and Grand Forks are presented in Appendix E of this report. Tables E-1 (Grand Forks buildings and structures) and E-2 (East Grand Forks buildings and structures) list all the buildings and structures in these two cities within and riverward of the proposed levee or floodwall alignments. Specific information provided includes the type of building or structure, its official site number, the year it was built, its National Register eligibility status, whether it is located under or riverward of the proposed levee or floodwall alignment, and whether it was acquired under the respective city's buyout program. Table E-3 provides information on the known archeological sites and unverified site leads for the proposed project area including site number, type of site, section-township-range, National Register eligibility status, and location under or riverward of the proposed levee and floodwall alignments. Table E-4 provides a summary list of those properties for each city which as of July 1, 1998, are listed on or have been determined eligible for inclusion on the National Register of Historic Places.

In Grand Forks, a total of 36 National Register listed and eligible properties will be directly affected by construction of the proposed levees and floodwalls, not counting properties acquired by the city's separate 1997 flood voluntary buyout program. These 36 properties include six listed on the National Register (St. Anne's Guest Home, Boom Town Store #1, Red River Valley Brick Co., Viet's Hotel Annex, Thomas D. Campbell House, and Granitoid Pavement at Lewis Boulevard and at South 4th Street, Elm Avenue, and 4th Avenue South) as well as nine residences north of downtown, 19 residences south of downtown, the Sorlie Memorial Bridge, and the former Northern Pacific Railroad Bridge, all of which have been determined eligible to the National

Register. As of July 1, 1998, except for the above two bridges, no National Register listed or eligible properties will be directly affected in East Grand Forks.

Archeological sites of undetermined National Register eligibility which are known to be within or immediately adjacent to the proposed levee and floodwall alignment in North Dakota consist of a prehistoric cultural material scatter site near the English Coulee crossing and a reported, but unverified lead to an Indian cemetery riverward of 307 North 3rd Street. That cemetery was relocated to an unspecified location sometime prior to 1965. In East Grand Forks, the proposed levee alignment east of the Murray Bridge and north of the Red Lake River crosses the Grand Forks Lumber Company Sawmill site and an early twentieth century landfill. Additional archeological sites that may be affected by greenway developments riverward of the proposed levee and floodwall alignments are listed in Table E-4. Not all proposed greenway developments will be project related.

As of July 1, 1998, 41 buildings and structures in Grand Forks and 15 buildings and structures in East Grand Forks still need to have their National Register eligibility evaluated. Archeological surveys of the proposed levee and floodwall alignments, associated work areas and borrow areas, and the proposed greenway/floodway area riverward of the levees and floodwalls are scheduled for the fall of 1998. Formal testing to determine the National Register eligibility of any archeological sites which will be directly affected by levee or floodwall construction or by project-related developments within the proposed greenway area is scheduled for the spring and summer of 1999.

MITIGATION OF IMPACTS TO HISTORIC PROPERTIES

Those National Register listed or eligible properties which cannot be avoided by project construction will need to have the impacts mitigated through excavation, archival research, and/or formal Historic American Building Survey/Historic American Engineering Record (HABS/HAER) recordation. Construction of the levees and floodwalls will affect the overall historical integrity of the Grand Forks Downtown Multiple Resource Area, the East Side Residential Historic District (centered on the Reeves Drive area), and the Riverside Park Historic District (centered on the Lewis Boulevard/Riverside Drive area) to varying degrees. Adverse effects to the viewshed and overall setting of historic buildings located landward of the levees and floodwalls will be addressed through landscaping, wall treatments, or some other type of physical screening to the extent feasible. Because the proposed levee and floodwall alignments have been located as close to the Red and Red Lake Rivers as is geotechnically safe in order to save more residences, commercial buildings and city infrastructure, use of vegetation for visual buffers may not be possible along many levee reaches. Due to the number of historic properties to be directly and indirectly affected by project construction, some form of cumulative effects mitigation, probably involving the development of an interpretive exhibit or program for the general public on the historic aspects of East Grand Forks and Grand Forks, will also be implemented.

Flood protection project construction will start on a small scale in 1999 if the Water Resources Development Act of 1998 authorizes construction funding for the project. Major construction on the levees and floodwalls would begin in the year 2000 and be completed in 2005. Mitigation of adverse effects to historic properties will be conducted during the 1999 to 2001 field seasons and will be completed for a particular flood protection reach prior to starting construction at that location.

Real Estate

The cost analysis for the Grand Forks, ND and East Grand Forks, MN Flood reduction Project is separated into three parts, Grand Forks, ND, East Grand Forks, MN South of the Red Lake River and East Grand Forks, MN North of the Red Lake River. The analysis for the cost was further divided by the North Dakota (Grand Forks side) and the East Grand Forks side north of the Red Lake River and East Grand Forks south of the Red Lake River (Reference plan sheet plate 3, 4, 5, 74 and 127). Valuation analysis is determined by the Direct Sales Comparison Approach. Each type of land was analyzed individually from current sales in the area. Residential sales were analyzed by each individual neighborhood. The tieback levees and the diversion channels were valued at the agricultural land rate also established from current sales in the County.

Each plate provided by General engineering was analyzed individually. Permanent easement was valued at full fee simple rate. Temporary easement was valued at the rental rate or current lending rate. The established rate was concluded at 10% of the fee rate. Residential improved properties were valued by a sales analysis representative of each neighborhood. Commercial activities and on-going businesses to be taken were analyzed by the depreciated reproduction cost new of the improvement and included relocation and re-establishment for each. This is assuming each to be relocated and business continuing.

Finally, an accumulation of each plate in a summary analysis for each of the three areas for Lands and Damages and Relocation assistance was provided. An administrative analysis of the costs for administrative oversight by the COE and the administrative costs for the cities to go forth and acquire the parcels necessary to build the project were estimated. The breakout of acres of real estate acquisition of unimproved lands, and the structures that are to be relocated for Grand Forks, East Grand Forks (north end), and East Grand Forks (south/Point end) follows:

Area of Community	Acres of unimproved lands required	Homes to be acquired	Businesses and public buildings to be acquired
Grand Forks	405 acres fee title 264 acres temporary easements	206 single family homes 24 apartments 11 condominiums	6 businesses RDO water treatment plant , Portion of City water treatment plant
East Grad Fork (north end areas)	177 acres fee title 49 acres temporary easements	16 single family homes 60 apartments No condominiums	10 businesses
East Grand Forks (south/Point areas)	153 acres fee title 37 acres temporary easements	30 single family homes No apartments No condominiums	No businesses

Contingencies were applied at the rate of 20% because of the unknown elements. Final conclusion was provided to cost estimating. For more technical detailed information see Appendix F of the Supplemental Documentation report.

Structural Design

Structural Engineering for this report consisted of stability analyses and sizing of significant members for the structural features identified on the project. Structural features associated with this project include floodwalls, railroad and roadway closures, drop structures, interior flood control structures, and miscellaneous drainage structures.

The primary objective of this effort was to determine feasibility of designs and establish reasonable quantities for the baseline cost estimate. The level of design was conducted to sufficient detail to attain these objectives. The design of structural features followed governing Corps criteria as follows: EM 1110-2-2502, Retaining and Floodwalls (Floodwalls, Closures, and Headwalls), EM 1110-2-2705, Structural Design of Closure Structures for Local Flood Protection Projects (Closures), EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures (all reinforced concrete), ETL 1110-2-307, Flotation Stability Criteria for Concrete Hydraulic Structures (pump stations and gatewells), and EM 1110-2-2902, Conduits, Culverts and Pipes (all drainage culverts).

Floodwalls and closures are reinforced concrete cantilever T type. All closures are the stoplog type. There are over 11,000 lineal feet of floodwalls ranging in heights from about 8 to 18 feet. There are 16 separate roadway and 3 railroad closures ranging in heights from about 5 to 17 feet. Load case I2, as described in EM 1110-2-2502, was assumed to be the controlling load case for floodwall and closure designs. Base slabs are embedded 6.5 feet for frost protection and are founded on a 6-inch-deep working platform of granular bedding. Concrete keys were used to aid in sliding resistance. A soil crack was assumed to exist to the bottom of the key and the seepage path taken from the key to the top of soil on the protected side. Closure stoplogs were designed assuming supports at 5-foot intervals using propped wide-flange beams.

Drop structures are reinforced concrete supported on steel H-piles. A cutoff key is attached to the downstream end of the slab to aid in erosion control. Two loading conditions were investigated, water to the top of the structure walls, and no water loads. Walls were designed as cantilevered members subject to soil and water loads and the slab was designed as a simply supported member subject to bearing pressures. Sliding and bearing stability were evaluated following criteria from EM 1110-2-2502. Drop structure retaining walls were sized based on wall configurations of a similar project.

Interior flood control structures include pump stations, gatewells, headwalls, and drainage conduits. Pump stations, gatewells, and headwalls are reinforced concrete supported by shallow foundations except for the large pump station at Belmont Coulee which is founded on steel H-piles. The large pump station includes a superstructure constructed of masonry block walls and a steel truss and metal panel roof. All combined pump

stations and gatewells, except for the large pump station at Belmont Coulee and the inlet and outlet structures at Hearstville Coulee, were sized based on structures of similar size and configuration at other projects. The large pump station and inlet and outlet structures were analyzed for bearing and flotation stability. Structural members were designed assuming flat plate behavior, where applicable; otherwise, beam behavior was assumed. Building design was based on design of a similar project.

Miscellaneous drainage structures consist of pump station and gravity outlet and inlet conduits, sewer interceptor conduits, and roadway drainage ditch conduits through levees. The latter conduits are attached to headwalls with flapgates. All conduits are precast, reinforced concrete pipes (RCP). General design assumptions for these items are that inverts are 10-feet below ground elevation and class 5 RCP satisfy strength requirements. Actual pipe designs were conducted where load conditions were known. Headwall designs are based on past experience.

See Appendix I for a complete description of structural design.

Mechanical Electrical

The pump station and gravity flow gatewell outlet designs for the mechanical and electrical systems will be coordinated with interior drainage requirements. Pump station designs will be segregated into three design categories. The final design categories will be selected based on system capacity requirements developed from the interior drainage study of the hydraulic design. The three preliminary design categories adopted include small stations (1-5 cfs.), medium stations (5-170 cfs.), and large stations (>170 cfs). Pump station design will be standardized within each category. Alternate studies for type of pump and prime mover will be developed in the interior drainage design memo. The stations will be suitable for location in an urban area with either floodwall or over-the levee discharge lines.

The following publications will be used to establish the capacity and layout of pump stations:

TM 1110-2-3105 - Mechanical and Electrical Design of Pumping Stations

TM 1110-2-3103 - Architectural Design of Pumping Stations

Hydraulic Institute - Standards for Centrifugal, Rotary, and Reciprocating Pumps (14th Edition) 1997.

The mechanical design will include the development of the general plant layout for each station category. This will include the pumping equipment, discharge pipe selection and layout, water control gates, trash racking, equipment handling cranes, and heating\ventilation. The analysis will also review pumping station equipment maintenance and repair criteria. The design will be closely coordinated with the engineers preparing the structural design.

The electrical design will include the establishment of electric service, and pump station power, control and lighting systems. Pumping stations protecting high value areas will include

an emergency standby generator. All pumping stations will have provisions for connection of an emergency standby generator. A small Supervisory Control and Data acquisition (SCADA) system will be installed at each pumping station. The SCADA system will simplify management of the large number of small pumping stations included in this project.

Cost data for the construction of mechanical and electrical features will be included in the cost engineering study prepared for this report. Design refinement will be necessary to develop pumping station concepts that provide for the most cost-effective product.

Greenway Plans

GREENWAY CONCEPT

The initial Conceptual Greenway Plan was prepared by a team of Landscape Architects and a Cost Engineer from the St. Paul District Army Corps of Engineers in response to a North Dakota Congressional request. The objective was to integrate a Greenway concept for the area between the rivers and the permanent flood protection boundaries that would be acceptable to communities of East Grand Forks and Grand Forks. The Conceptual Greenway Plan prepared in May 1997 defines a strategy for controlling future flooding and providing recreation. The Greenway envisioned in the concept plan would encompass over 2,000 acres of land between the two cities.

To refine the first Conceptual Greenway Plan and to gain involvement and support from local officials, sponsors, community groups, the public, adjacent landowners, businesses, and State and Federal agencies, the Corps of Engineers hired a Greenway consultant to facilitate two Greenway Workshops. They were held on February 5 and 6 and on March 11 and 12, 1998. The object of these workshops was to bring together a multi-disciplinary group of people to 1) Unify the communities in a common purpose, 2) Set a vision, goals and objectives, 3) Identify an action plan required to implement the vision, and 4) Create partnerships for the design, funding and maintenance of the Greenway. The contractor, Greenways Incorporated, from discussions that took place at the workshops, prepared the Red River of the North Greenway Report (see Appendix G of the Supplementary Documentation Report for additional information).

Based on the inputs received from the workshops, the Corps revised the Conceptual Greenway Plan in June 1998. The next step in realizing a greenway is to prepare a coordinated master plan for the Greenway. This needs to be accomplished at the local level with limited Corps involvements. Figure 3 shows the revised Conceptual Greenway Plan for the greenway.

It is important to understand that the proposed recreation development to be done as part of the Federal flood reduction plan will not complete development of the Greenway. The extent of the greenway development that will be accomplished as a result of the flood reduction project will be limited to the development of a perimeter trail system with a number of trail entry points, parking, restrooms, trailhead information facilities, and limited day-use facilities for picnicking. The trail facilities will provide a circulation framework and the parking and

restrooms will provide critical support facilities upon which additional locally designed and implemented greenway development can be built. In order to realize the full potential of a greenway, a locally lead greenway master plan has been discussed; and the City of Grand Forks has identified/assigned a local greenway coordinator, and a joint powers agreement has been initiated to establish a local political entity with the responsibility to plan, implement, and operate the greenway.

BENEFITS OF A GREENWAY

Opportunities abound with the addition of the Greenway including widening the floodway, economic revitalization, restoration of ecological river systems, providing recreation, improving health and physical fitness, and unifying the communities. The Greenway may serve to hold the communities together by providing a common bond, sense of belonging, spiritual, or emotional value when the residents become involved in the greenway planning and development process. Sharing and getting involved in planning the Greenway can provide an opportunity to work on projects, meet others, learn, talk about their experiences, and go through the healing process. Residents can pursue their area of interest in cultural/historical resources, recreation/open space, landscaping and gardens, environmental education, enhancing biological diversity, improving water quality, creating a memorial space, or other endeavors.

In addition, to providing areas of undisturbed and restored floodplain, the Greenway can offer a place to recreate, socialize, provide walking and biking opportunities, and improve the visual aesthetic quality by enhancing views, adding buffer zones, and land shaping to fit into the surrounding landscape. Higher real estate values may also be reflected in the land surrounding the Greenway.

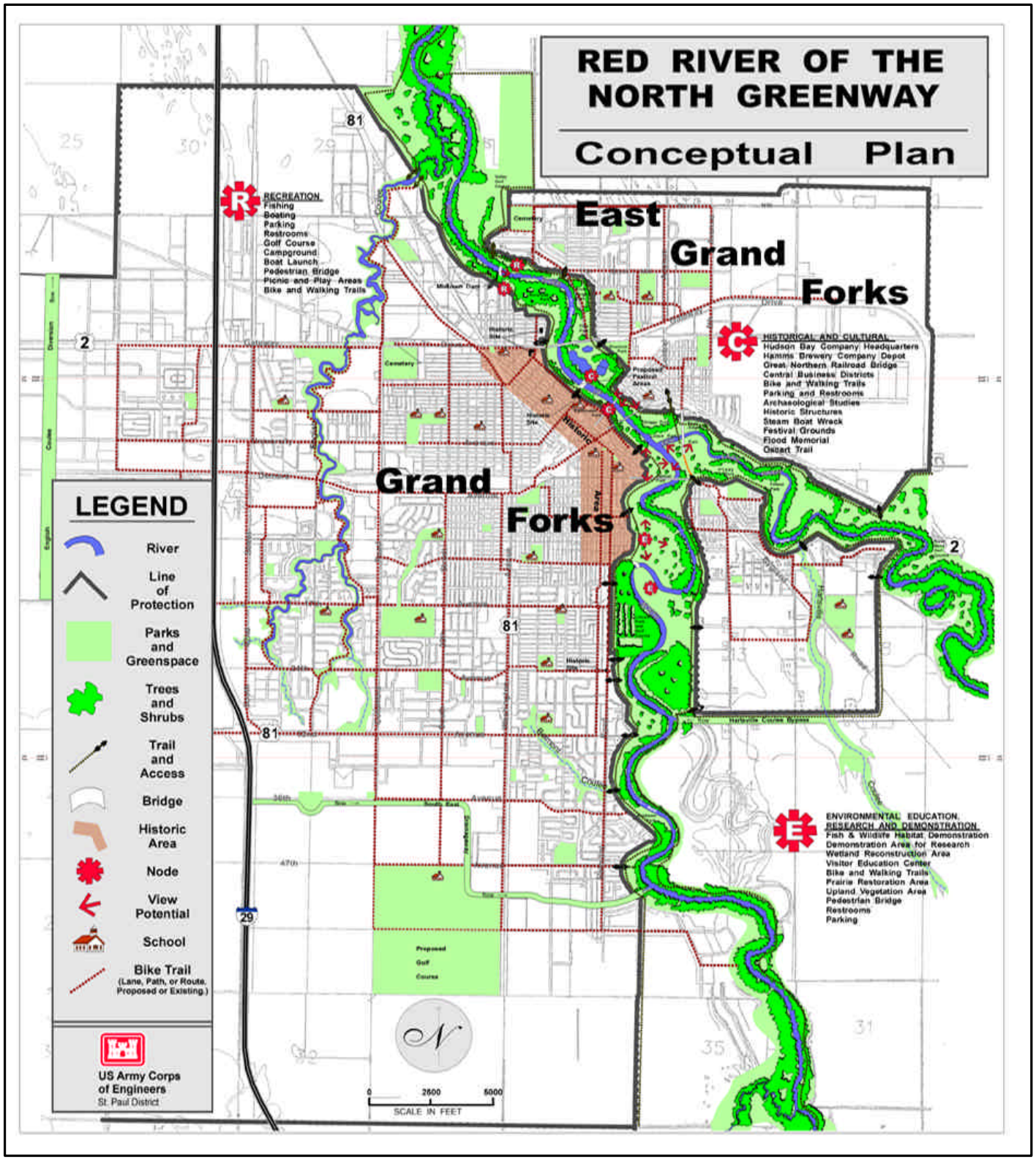


Figure 3 – Greenway Concept Plan

CORPS AESTHETICS AND RECREATION FEATURES

The recommended plan is a multi-purpose project that includes recreation and aesthetic features. The recreation and aesthetic features have been integrated into the design and cost estimates for the recommended plan presented in this report. A more detailed discussion and description of these features follows.

Aesthetics - Visual Quality Assessment

Aesthetic designs and features are considered to be an integral part of the overall project design. Accordingly, landscape plantings and earthen warp sections have been identified and integrated into the design of the recommended plan, are now in the cost estimate that has been prepared for implementation of the recommended plan, and will be further evaluated during the detail design efforts. These aesthetic features are cost shared as a basic cost of the flood reduction features. The extent of aesthetic features to be implemented, as part of the project is dependent upon the Local Sponsors priority for seeing such features integrated into the project[1]. Also, the design of aesthetic features must be consistent with the primary flood reduction design criteria and Corpswide design standards. Because there are major soil stability problems in the study area and there is a strong desire to minimize the number of structures that are impacted by the construction of a permanent flood reduction project, the project alignment has been moved riverward to the maximum extent practical. As a result, the space that is available to implement aesthetic features is not available or is very small in many areas. This adversely affects the Corps ability to integrate aesthetic features in those areas. This is particularly a problem in some residential reaches of the recommended project. In spite of these real world constraints, aesthetic inventories and integration of designs for aesthetic features have been accomplished wherever possible as part of the proposed project.

INVENTORY OF VISUAL RESOURCES

Visual resources are an important part of any Corps of Engineers project. The US Army Corps of Engineers Visual Resource Assessment Procedure (VRAP) were to evaluate the visual resources of East Grand Forks and Grand Forks that will be affected by the Corps flood reduction project. The VRAP process includes identification of the regional landscape, an inventory of existing visual resources, assessing visual impacts, obtaining public input, evaluating alternative plans and solutions, and forecasting with and without project conditions using visual simulations to show design alternatives.

[1] There are limits upon the type and cost of aesthetic features that can be allowable and cost shared as a basic part of the project. However, betterments are possible, at the non-Federal Sponsor's option, for any additional aesthetic treatments that go beyond type or funding limits allowed.

Visual quality is based on several factors, formed from many components. The visual quality of a landscape is based on factors such as variety, interest, and views. These factors are comprised of color, texture, form, and line (each with their own components) and influenced by elements such as space, light, the senses of the observer (smell, feel, hear), and impacts (such as scarcity and disturbance). All of these play over the landscape which, in turn, is made up of its own set of components: land, water, vegetation, structure, etc. Aesthetics can be defined as being concerned with the characteristics of objects or collections of objects (in this case, the landscape) and the specific human perceptions that make them pleasing, or displeasing, to our senses. It should be observed that there are many definitions of "aesthetics," and no agreement as to the use of the word. Aesthetic attributes refer to perceptual stimuli that provide diverse and pleasant surroundings for human enjoyment and appreciation. Sights, sounds, scents, tastes, and tactile impressions interact with natural resources and cultural influences to produce psychological feelings of pleasure in certain landscapes but – all humans are different – thus aesthetic attributes are subjective. The old adage "Beauty is in the eye of the beholder" still holds true.

Historically, this is the northeastern edge of the Great Plains of North America -- a vast expanse of rolling, grass covered hills inhabited by semi-nomadic Native American tribes. Today, the region is part of the Midwestern farm belt, the "Bread Basket of America." It is a sparsely populated area – a rural landscape that stretches across the center of the continent for hundreds of miles. About 50 to 70 miles to the east of the project is the vegetative transition zone where the naturally occurring, rolling grassland changes to northern coniferous forest, dotted with thousands of lakes and streams.

This region comprises the eastern edge of the Northern Great Plains, and the native biota is both wet and dry prairie dwelling species. Historically, vegetation consisted of grasses, sedges and wildflowers on the vast level areas, and occasional patches of northern floodplain forest along the streambanks and in the gullies. As the prairies were periodically swept by tremendous fires, the only woody plants in the area were those that survived them. As a natural consequence, stands of native trees and brush were few and widely scattered, found only on the streambanks or in naturally protected areas. Today, the region is part of a vast, rich agricultural network stretching from the Rocky Mountains to the lakes region of Minnesota.

Professional evaluators have completed the visual similarity zone map (see Figure G-B) and the VRAP inventory for East Grand Forks and Grand Forks. More detailed evaluations of project visual quality will be prepared and coordinated during the next phase of the flood reduction project using the visual similarity zone map and the visual assessment inventories for Grand Forks and East Grand Forks. This will be accomplished after the General Reevaluation Report is completed as part of the detailed design that will follow. This evaluation will include:

- Identifying significant visual resource impacts to be avoided (soil stability/erosion, etc.).

- Predicting adverse changes in the visual resources, such as site specific components (e.g., riparian vegetation) that should be protected to preserve existing visual and environmental quality.

- Examining the landscape composition to identify the spatial dominance, scale, contrast, and compatibility of landscape elements and characteristics.

- Combining public and professional input to determine what visual changes are acceptable.

- Recommendations on how to proceed into the design phase will address items such as floodwall treatments, blending levees into surrounding topography, limiting access to areas of high visual quality, and visual screening (using trees and shrubs to improve the visual qualities of the project).

Public Input

Gathering visual resource information and concerns from the public will need to be accomplished at future public workshops and neighborhood meetings to be accomplished during the detailed design phases after this General Reevaluation Report.

Evaluation of Alternative Alignments

Early computer generated visual simulations of project alternatives have been invalidated by changes in the levee and floodwall (flood reduction structures) alignment. Additional simulations of project alternatives will be prepared during the next phase of the flood reduction project. Areas of concern will be noted as part of the VRAP process.

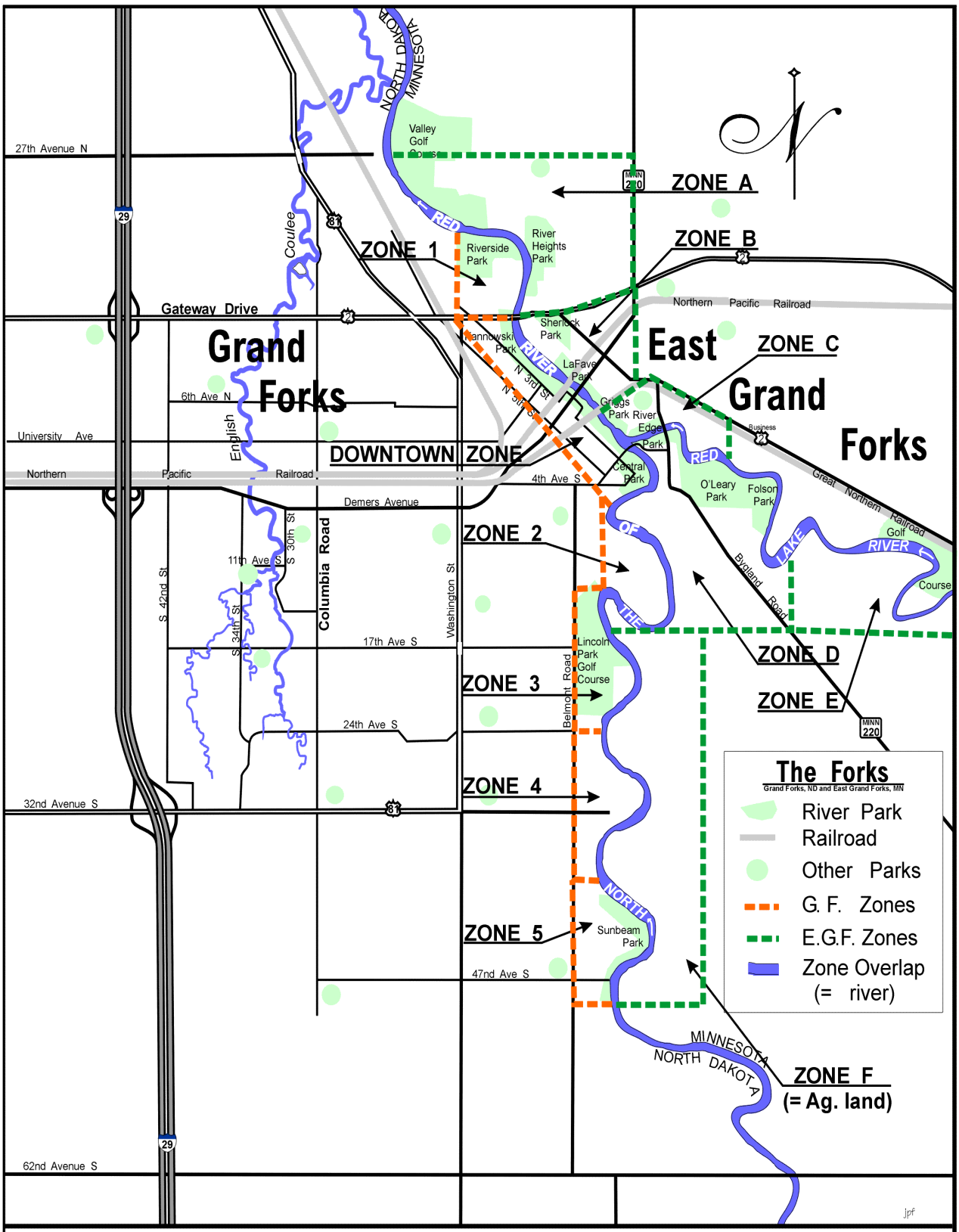


Figure G-B **Grand Forks, East Grand Forks – Visual Resource Zones**

Aesthetic Issues of concern

Physical barriers and overwhelming visual dominance issues have been created by the height of some of the floodwalls and levees. This could have a negative impact on the visual qualities of the project and undermine public enthusiasm, support, and participation in the project. Specific causes for concern include:

- Cultural/historic areas where levees or floodwalls will be built.
- Extremely high floodwalls or levees in some neighborhoods.
- Views of typical levee construction (1:3 slopes).
- Views of specific levee or floodwall treatments.
- Walls that block existing pedestrian/bike connections.
- Walls or levees that block prominent views of open, urban green space.
- Walls or levees that block views to the river.
- Fitting walls/levees into the surrounding landscape (especially neighborhoods).
- Lack of real estate for levee overbuild and landscape plantings (naturalization).
- Lack of pedestrian spaces near the levee – auto dominant planning and design.
- Lack of space for the “Fingers of Green” concept of the Greenway plan.

Measures to lessen visual impacts

- Levees may be graded and shaped into undulating natural shapes and planted with trees and shrubs (naturalized) to fit into adjacent neighborhoods. Due to limited space between the levee/floodwall and adjacent residences, businesses, and other buildings, there may not be enough space in many areas for this type of aesthetic treatment.
- Landscaping may be provided to minimize impacts and blend walls and levees into the surrounding landscape. Vegetation can be used to minimize the visual and physical dominance of high flood reduction structures by visual screening, providing or distorting scale, presenting diversity and piquing interest.
- Wall treatments will be needed to lessen visual impacts in historic as well as non-historic neighborhoods.
- Significant viewsheds will be addressed.

- Areas for wall enhancements and special features in the commercial downtown areas will be identified.

RECREATION FACILITY NEEDS

The purpose of this section of the report is to quantify and evaluate recreation resources available to the residents of Grand Forks, North Dakota, and East Grand Forks, Minnesota, and assess the recreation potential of the area. This report examines the recreation resources of the cities and of the area readily accessible to the recreation users of the two cities; i.e., the area of influence. This area of regional influence is commonly held to recreation resources that can be reached within 1 hour, or within a 50-mile radius of the population center. A 50-mile radius is shown on Figure G-1 below.

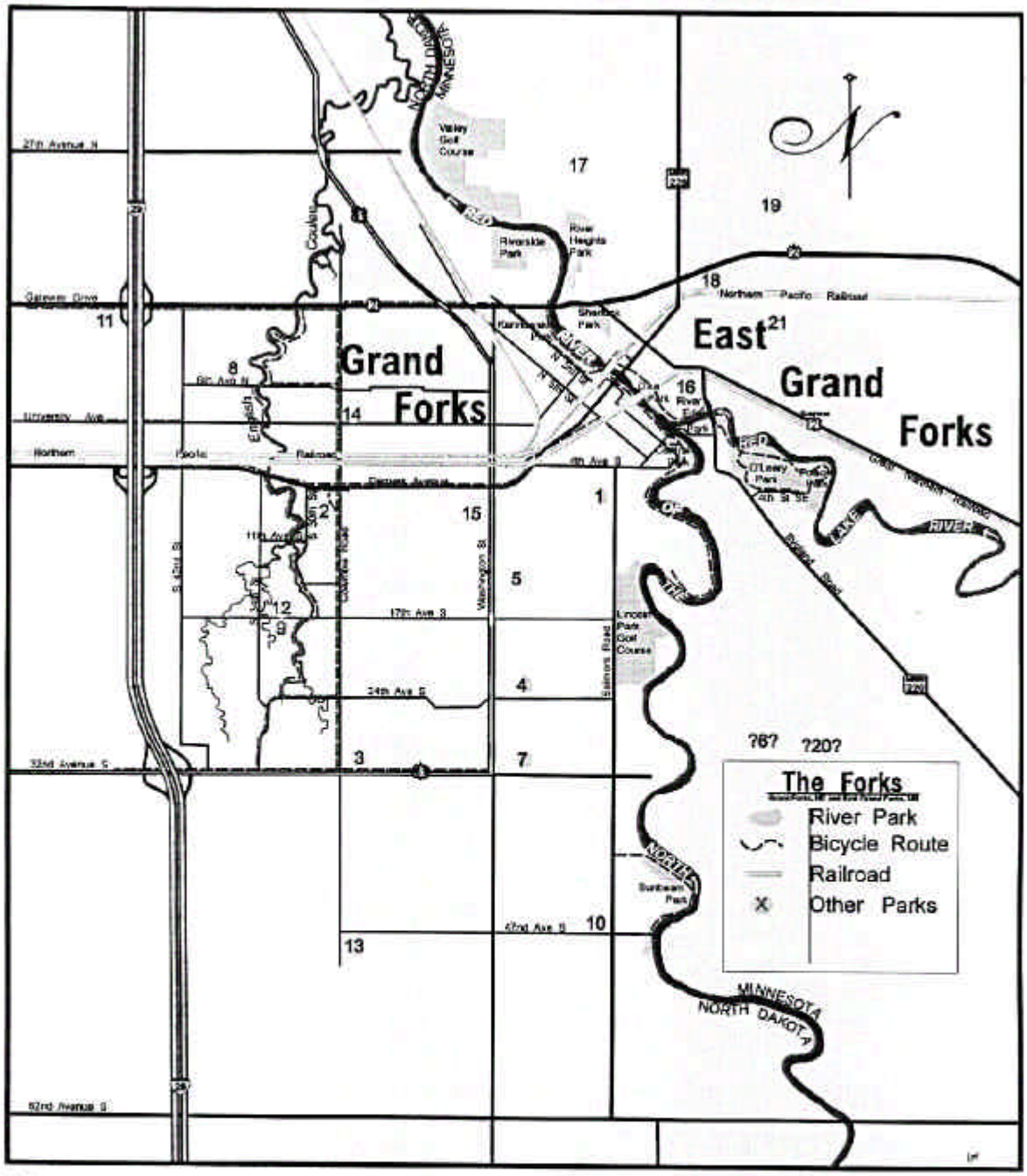
Figure G -1. Regional Influence

Local Recreation

Grand Forks - The City of Grand Forks had a population of about 52,500 before the devastating flood of 1997. Because Grand Forks is a metropolitan growth center, it has experienced a consistent rate of natural increase over the last decade. Population growth has been due to natural increase and the expansion of employment opportunities. Expectations before the 1997 flood predicted that the economy would expand as a metropolitan service and trade center, in major retail facilities, and in improved and expanded medical facilities. A recent news article estimated a drop of approximately 2,000 residents since the flood, bringing the population count down to around 50,000 people in 1998. If moderate growth continues at a 9-percent annual growth pattern the population is expected to reach 58,000 to 60,000 by the year 2020. Existing park facilities are shown on Figure G-2.

There are approximately 550 acres of parks, open space and public recreation land within the city limits, with an additional 400 acres of parks, open space, and recreational facilities outside the city limits. Outdoor recreation areas include roughly 20 public parks and 4 golf courses. Five parks, listed below, are located within the flood reduction project boundaries.

- Sunbeam Park is located at the south (upstream) end of the city. This strip park follows the meandering Red River and features a paved multipurpose trail along its entire length and old growth forest at the south end.
- Lincoln Park is a more traditional park with a picnic area and shelter, horseshoe pits, play equipment, tennis courts, flower gardens, and restrooms. Lincoln Park also features a public 18-hole golf course with a clubhouse and parking for 150 cars. Cross-country skiing is offered in the winter. This park serves as a valuable visual corridor along Belmont Road. The golf course is an attractive open green-space within an urban setting, offering panoramic views to surrounding residents. North Lincoln Park has a warming house, playground, and flower gardens adjacent to the golf course.
- Central Park is also a traditional park providing picnic facilities and a shelter, horseshoe pits, play equipment, flower gardens, a bike trail and restrooms. It also has skating and hockey rinks for winter use and provides an auto tour.
- Kannowski Park is a small park between the downtown area and the Red River. It is adjacent to the downtown business district and has flower gardens, benches and shelters, a gazebo, water fountain, bike racks, a bike trail and a sidewalk system that connects Central Park to the south and Riverside Park to the north. The historic Great Northern Railroad Bridge serves as a major pedestrian corridor linking Grand Forks to East Grand Forks. The renovated railroad station serves as a tourist information center.
- The City of Grand Forks owns the Riverbank strip of land between the Kennedy Bridge and the Point Bridge (Minnesota Avenue). This strip provides about 50 acres of valuable open green-space for the City's trail system.
- Riverside Park is located at the north (downstream) end of the project. As a traditional park, it provides picnic facilities and shelters, 4 tennis courts, baseball fields, open field, play equipment, horseshoe pits, flower garden, skating and hockey rinks, warming house, a swimming pool and bathhouse. Riverside Park is an attractive open green-space within an urban setting, offering panoramic views to surrounding residents. Park trails link to Kannowski Park and the downtown business district via low traffic, historic Lewis Boulevard.



Other Parks:

1. Abbott Park
2. Ben Franklin Park
3. Bringewatt Park
4. Cox Park
5. Elks Park
6. Haake Strip Park
7. Kelly Park
8. Lake Agassiz Park
9. Lions Park
10. Optimist Park
11. Richard's West Park
12. Sertoma Park
13. Ulland Park
14. University Park
15. Wilmar Park
16. Griggs Park
17. Harney Park
18. Hecht
19. ITT's Williams Park
20. Nash Park
21. Strauss Park

Figure G-2 Existing Park Facilities

Source: Grand Forks Park District and East Grand Forks Park and Recreation

Grand Forks Park District Survey -*The purpose of this survey was to gain information that could be used to support Park District decisions for future community recreation facility needs. The full report is not yet available, but the preliminary results of this survey show that respondents overwhelmingly selected Trails in the Greenway (45.4%) as the top priority for new recreation facilities, and More Parks and Picnic Areas (33.5%) as the second priority. Outdoor Winter Sports Area had a 26% preference and Playground Improvements had 25.3% preference. Participation frequency rate for Individual Fitness and Sports was 51.8% and for Outdoor and Nature was 32.4 %. Other recreation facilities that were preferred by local area residents included (in order of importance) an indoor swimming pool, a community recreation center, a new golf course, a campground, community gardens, and several other recreational facilities.*

East Grand Forks - East Grand Forks has a considerably smaller population base and is bisected by the Red Lake River. The current population figure, at about 7,050, is a decrease of approximately 1,000 to 1,600 people since the 1997 flood. If population trends continue with an 8-percent growth pattern, as before the flood, the population projection though the year 2020 is between 8,000 and 9,000 people.

The city of East Grand Forks has established several parks along the south side of the Red Lake River and along the east bank of the Red River. About 14 parks have over 200 acres combined total. Seven of these parks are located within the flood reduction project boundaries. Existing park facilities are shown on Figure G - 2.

Parks located on the Red Lake River:

- Folson Park – large open area for passive trail use – has a boat launch
- O'Leary Park – offers year round facilities - trail
- Griggs Park – small playground and skating area

Parks located on the Red River:

- Rivers Edge Park – Campground, boat launch and trail
- LaFave Park – Fishing and trail use
- Sherlock Park – Full facilities – swimming pool
- River Heights Park – Picnic and playground facilities
- Valley View Golf Course

East Grand Forks Parks and Recreation Survey- The purpose of this survey was to assess the recreational needs of the community for future recreational facility planning and development. The survey was completed in February 1998. Catfish Days was one of the most highly rated and popular annual events celebrated on the Red and Red Lake Rivers.

Results of the East Grand Forks survey indicated that over 87% of the sample rated recreation as important to their quality of life. The top 10 recreational activities the respondents participated in are (in order): 1) watching TV, 2) socializing with friends, 3) reading books, 4) walking for exercise, 5) bicycling, 6) church/religious activities, 7) movie theaters, 8) fishing, 9) playing video/computer games, 10) attending plays or musicals.

An open-ended question at the end of the survey asked: "When the new dike alignments are completed there will be a lot of additional open space created along the river. What ideas do you have for the use of this area?" Since this was an open-ended question, many ideas were suggested, from ball fields to townhouses. Out of 112 responses, the following key words were identified, counted and recorded (key words were selected that fit into an outdoor recreation experience that could be part of the Corps of Engineers flood reduction project). The most popular key word was Park followed by Green Space and Trees. Bike, Walking, Hiking, and Jogging Trails were mentioned as the second most important facilities. Other important recreational facilities listed were Campgrounds; Fishing Opportunities; Playgrounds; an Amphitheater, Event and/or Music Area; Cross-country Skiing; and Picnicking.

LAWCON FUNDED PROJECTS

The Land and Water Conservation Fund (LAWCON) is administered by the National Park Service (NPS) to provide funds for local recreational development. Grand Forks received LAWCON grant money for four projects located within the flood reduction project area. They are the Central Park combination building, Lincoln Park playground and combination building, Lincoln Park golf course irrigation, and Sunbeam trail. The property acquired or developed with LAWCON funding cannot be converted to another use and must remain in public outdoor recreational use. Coordination has taken place with the NPS Grant Program Leader and the North Dakota Grants Manager. They have reviewed our recreation plans, and in their opinion, no negative impact on LAWON sites is expected. However, they recommend close coordination with the City of Grand Forks to ensure that any changes will not constitute a conversion of recreation land.

No Federal LAWCON funds were used for recreation in East Grand Forks. Instead, the State Grant Program, modeled after the LAWCON grant, provided facilities at O'Leary and Riverside Parks. These parklands must be maintained solely for outdoor recreation and made safe and accessible to the public. Close contact with the City is recommended, as the Flood reduction Project is designed and constructed. Coordination through letters with a follow-up meeting to show the recreation plan to the Minnesota DNR took place in April and May. After review of our recreation plans the DNR reached agreement that they will not require a formal appraisal or survey but want to identify replacement park within the Greenway. They will do this with coordination through the city of East Grand Forks.

North Dakota SCORP Information (1996-2000) - This State Comprehensive Outdoor Recreation Plan (SCORP) is a guide for developing and managing North Dakota's recreation base to determine future outdoor recreation priorities. The recreation survey indicated that Region 4 had a high participation rate, in order of importance, for Picnicking (62%), Pleasure Driving (58%), Walking/Jogging on paved trails (50%), Swimming (44%), Bicycling on paved trails (43%), Boating/Water-skiing (42%), and Golf

(41%). The most needed facilities listed in Region 4, in order of importance, were Paved Biking Trails, Picnic/Playground Areas, Developed Campgrounds, Paved Walking/Jogging Trails, Swimming Pools/Beaches, Hiking Trails, Open Space Parks, and Historic Parks. North Dakota bicyclists want more trails, especially if they are paved. Over half the bicyclists thought adding signs, providing maps, and enhancing public awareness of trails and facilities would improve the bicycling climate. Over half of the respondents said they were interested in preserving wetlands.

Turtle River State Park is located in Region 4 and was established in 1934 by the State Historical Society because of the large number of log and stone structures. Woodland Lodge, constructed along the river in 1938, is still used for family gatherings and park events. The Civilian Conservation Corps constructed the park. In 1995 the number of visits to the park totaled 124,380. The entire park is a nature sanctuary containing a rich diversity of wetlands, mixed hardwood stands, floodplain forest, timbered uplands and prairie areas. Turtle River State Park is located 22 miles west of Grand Forks on Highway 2. The 784-acre park offers Camping, Picnicking, Trails (interpretive, self-guided nature, bike, mountain bike (2.5 mile)), horseback (rentals), fishing, snowmobile and 10K of groomed trails for Cross-country Skiing. Sections of the river are stocked with rainbow trout in a cooperative effort with the N.D. Game and Fish Department. Special Programs are featured at the outdoor amphitheater.

Larimor Dam is a county water reservoir lake that offers fishing (limited motor use), camping, swimming, picnicking, and nature study arboretum. Annual visitation is estimated at 100,000.

Minnesota SCORP Information (1995-1999) - This Minnesota State Comprehensive Outdoor Recreation Plan (SCORP) was prepared to surface recreation issues and strategies as a guide for developing and managing Minnesota's outdoor recreation. As recreation interests diversify and society becomes more complex, outdoor recreation issues increase. The SCORP identified six high-priority issues: 1) Sustainable Outdoor Recreation (environmentally sustainable and interdisciplinary approach), 2) Roles and Responsibilities (effective partnerships between providers – improved recreation programs), 3) Capital Investment (funding for acquisition, development, redevelopment, new programs and research), 4) Liability and Litigation (may limit recreation opportunities and increase costs), 5) Operations and Maintenance (funding constraints cause deterioration – liability and diminished quality of recreation experience), and 6) Recreation Research (need information to effectively provide useful facilities and programs).

Outdoor recreation behavior and leisure patterns are changing and identifying long-term strategies is necessary. The State's elderly population will increase nearly 70 percent as the *baby boom* generation enters middle age and their leisure choices influence recreation patterns. Many people today have a limited amount of leisure time leading to a trend in recreation preferences: people tend to vacation more often, for shorter periods, closer to home. Changes in recreational patterns need to be monitored to determine shifts in participation that change for boomers, prior generations, the *Baby Bust*

generation and upcoming generations. Shifting of recreation facilities use will have major implications for management. Since the leisure ethic remains strong in our culture, spending remains strong, and travel and tourism are important to employment and economics. Trends suggest that shifts in recreation preferences and expectations will provide strong competition for recreation dollars.

Old Mill State Park (300 acres) is approximately 40 miles northeast of East Grand Forks. The park accommodates campers, skiers, and snowmobilers, and conducts an interpretive program. The total number of visitors in 1990 was 28,996; in 1991 was 33,570; and in 1992 was 27,153. The Old Treaty Crossing Wayside Park is approximately 30 miles southeast on the Red Lake River. The Red Lake River is considered a recreational river for canoeing and boating.

The State's recreation economies rely heavily on a land and water base that is environmentally healthy. The quality of Minnesota's public and private lands and waters is increasingly degraded. This impact will seriously limit outdoor recreation opportunities if the trend is not reversed.

EXISTING FEDERAL RECREATION - Kelly's Slough National Wildlife Refuge is just west of Grand Forks, North Dakota, off U.S. Interstate 29 and U.S. Highway 2. This refuge (3.966 acres) was established in 1936 to be used as a refuge and breeding ground for migratory birds and other wildlife. In addition to the refuge, Federal waterfowl production areas (3,400 acres) were purchased to promote the conservation of migratory waterfowl and to offset or prevent the serious loss of wetlands and other essential waterfowl habitat. Recreational opportunities include parking, an information kiosk, a wildlife observation deck, interpretive signs, a self-guided auto tour, and foot trails leading to another observation deck. The managed wetlands and uplands offer exceptional bird watching opportunities year-round. Birdwatchers come from all over North America to catch a glimpse of the estimated 280 species.

The only Federal Management Unit in Minnesota that is near the project site is the Agassiz National Wildlife Refuge. It is not within the 50-mile area of regional influence since it is approximately 65 miles northeast of East Grand Forks, Minnesota.

RECREATION FEATURES OF THE PROPOSED PLAN

RECREATION DEMAND

The Park District in Grand Forks and the Parks and Recreation Department in East Grand Forks have long recognized that open space and parklands are a valuable resource to the community. An analysis of current local recreation, local survey's, SCORP information, public input during Greenway workshops, recreational professionals input, and available State and Federal recreation was accomplished. Multi-use trails lead the list of the most important facilities participated in and requested for, with Parks and Picnic areas in second place.

Population Market Area

Population trends for Grand Forks and East Grand Forks were obtained from each cities Land Use Plan dated 1996 and 1995 respectively. Each city is looking at a moderate growth pattern. Moderate growth for Grand Forks is 0.9% and for East Grand Forks 0.8%. The 1990 population figure is from the US Census. Projected growth using the 1990 population figures is not valid since the 1997 flood forced many people from their homes. Therefore an assumption that the 1998 population figure, from a recent news article depicting population losses after the 1997 flood, will hold steady for about five years before any steady growth is realized.

Participation and Demand

Participation rates were derived from reviewing the North Dakota and Minnesota SCORP information, the Recreation Economic Analysis prepared for Rochester Minnesota, Local Planning Documents and survey's of Recreational Needs Assessments.

The North Dakota SCORP identified the most popular activities in 1995 by listing participation for Walking/Jogging Paved Trails at 50 %, Bicycling Paved Trails at 43 % and Picnicking at 62 %. The local area would like to see more winter sports and rated Cross-county Skiing trails as very compatible with using some bicycling and/or walking trails if the terrain is challenging. Grand Forks parks recorded picnic shelter reservations for 1996 (17,412 – party size). No other usage data was available to use in planning participation for the project. Participation rates were interpolated from earlier SCORP data to more recent SCORP data.

Participation rates are expected to rise slightly, based on the popularity of long distance bike touring, and the rise of walking for fitness for all ages, especially the "baby boomer" aging population. Our aging population will have more time to recreate. Keeping physically fit is very important to this generation. The University of North Dakota and the University of Minnesota - Crookston enrollments are expected to remain stable. College students will continue to participate in Bicycling, Jogging and Cross-country Skiing. Cross-country Skiing trails can be provided on existing trails on overbuilt levee slopes and within the Greenway to satisfy moderately advanced skiers. Numerous miles of trails through interesting terrain and across bridges should provide a variety of trails that will accommodate local skier's, who now travel to Bemidji, Minnesota. Bemidji is over 100 miles east of East Grand Forks. Bicycling, Cross-country Skiing, Walking/Jogging and Picnicking show an increase over a fifty-year period to reflect more recent SCORP information.

The projected public use demand (in activity occasions) is calculated using recreation activity participation rates, population projections for the cities of Grand Forks/East Grand Forks, facility design capacities, and professional judgement. The years for depicting projected growth were chosen to reflect a fifty year project life. The annual activity occasions were converted to activity days (recreation days). This was based on the number of different activity occasions each recreational user would engage in during the day.

Annual Recreation Benefits

Table (G-9) shows the existing and projected recreation visitation over the life of the project.

VISITATION (VISITOR DAYS)

Year	*Bicycling*	*Walking/ Jogging*	*Cross- Country Skiing*	*Picnic*
2004	0	0	0	0
2005	157,040	193,536	30240	27,200
2015	196,300	241,920	40,320	34,000
2035	237,680	370,181	50,400	40,800
2055	237,680	370,181	50,400	40,800

Table G-9

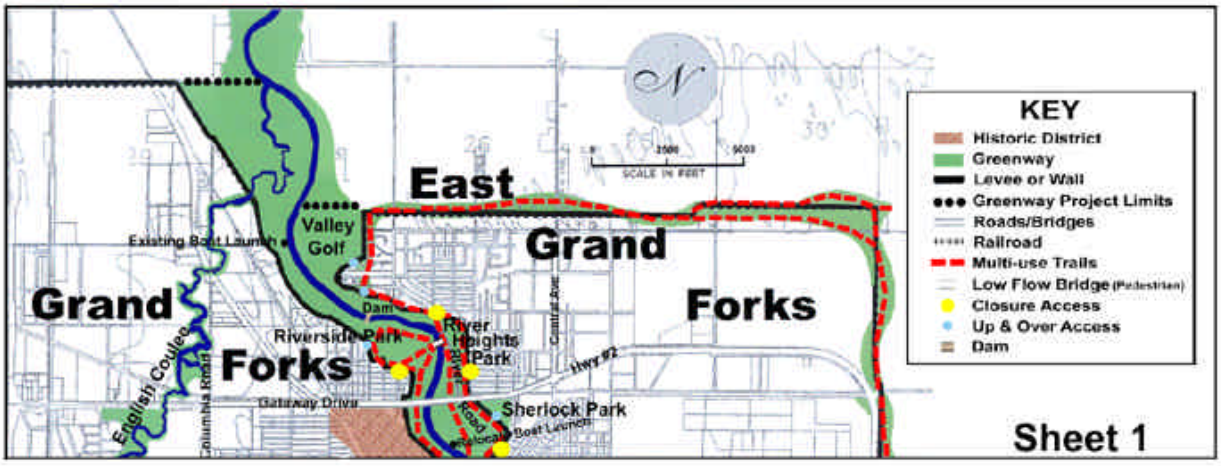
Benefit Computation

Recreation benefits attributable to the proposed trail system were based on projected demand for the four recreational activities listed above. These demand estimates over the life of the project were used in conjunction with Unit Day Values developed for each of the four recreational activities. The value of the recreational activity at each project year was converted to a present worth value using a 7 1/4 percent annual interest rate. The sum of these present worth values, by recreational activity, were converted to an average annual dollar value, given a 50 year project life and a 7 ¼ percent annual interest rate. Demand at each project year was multiplied by the appropriate Unit Day Value for each recreational activity. The value of the recreational activity at each project year was converted to a present worth value using a 7 ¼ percent annual interest rate. The sum of the present worth values was converted to an average annual dollar value, given a 50-year project life. Average annual benefits for Bicycling, Walking/Jogging, Cross-country Skiing and Picnicking came to $736,200; $1,132,600; $149,700, and $112,100 respectively. The total average annual recreational benefits came to $2,130,600.

Sheets 1 through 3 show the recreation concept plan that is proposed as part of the Federal flood reduction levee project. Identified on the concept plan is the levee or floodwall, multi-use recreational trails, three low flow bridges for bicyclists and walkers, and trail access points. Recreation trails are shown as a red dashed line with low flow bridges in white. Openings through the levee are identified as closure access and are shown as yellow dots. The up-and-over-levee access points are shown as light blue dots. Grand Forks will have pedestrian closure access points at Riverside Park, 8th Avenue North, Demers Avenue in Downtown, Minnesota Street, Central Park, Lincoln Memorial Park, and Lincoln Park Golf Course. Up-and-over levee access will be provided at Alpha Avenue and North 3rd Street, Elmwood Drive, Belmont Coulee/Sunbeam Park, and at the Sunbeam Park exit on 47th Avenue South. East Grand Forks will have pedestrian closure access points at River Heights Park on 8th Avenue, Sherlock Park, O'Leary Park, and Folson Park. Up-and-over levee access will be provided at Valley Golf Course, 19th Street, River Heights Park, Griggs Park, Timberline Court, Maplewood Addition, the Southwest Access and at Highway #2. As an option to the non-Federal sponsors, economically justified certain kinds of recreation features may the added to the recommended levees flood reduction project on a 50/50 cost-sharing basis. Generally, the recreation facilities are to be located on lands needed to implement the basis flood reduction project.

After careful coordination with the non-Federal Sponsors, it has been determined that recreation/greenway development features are desired and are consistent with Corps guidance. Recreation facilities that can be cost shared as part of the project include 1) multipurpose Access and Circulation Trails, 2) Toilets and Shelters, 3) Utilities, 4) Public Telephones, 5) Site Preparation and Restoration, 6) Park Furniture, 7) Play Equipment, 8) Signs, 9) Interpretive Guidance and Media, and 10) Items for Protection, Control, Health and Safety.

The recreation features to be implemented as part of the flood reduction plan will provide a framework for future Greenway development. The major focus of the recreation plan is to provide multipurpose bicycle/pedestrian trails, Walking and Jogging Trails, Cross-country Skiing Trails, and Picnic Facilities [2]. Figures 4, 5, and 6 show the specific recreation features proposed that are a part of the proposed Federal flood reduction levee project. For more details and plates presenting the recreation plan see Appendix G of the supplementary documentation report.



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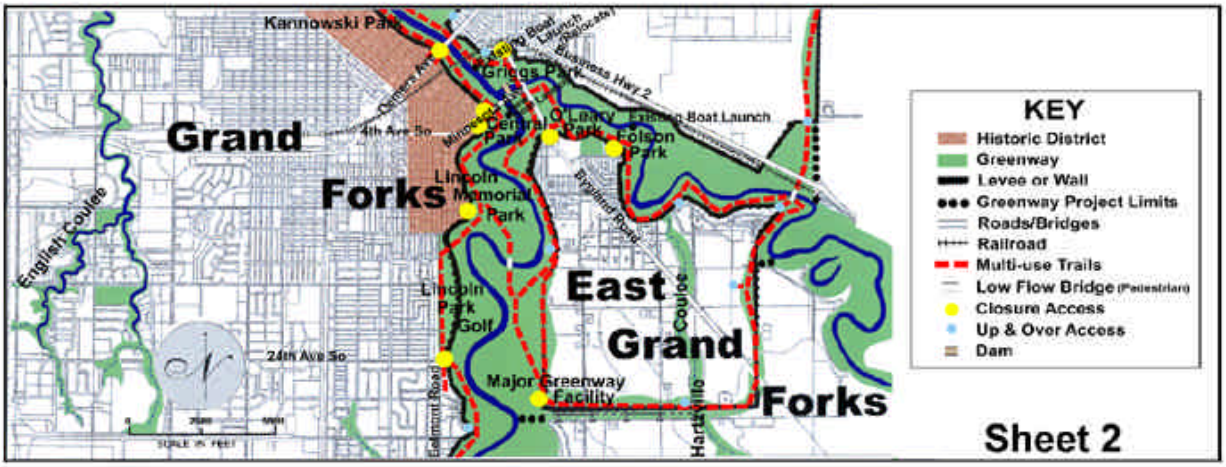
Recreation Plan Concept

[2] Only multipurpose trails can be cost-shared by the Corps, consistent with PGL 36 and Corpswide guidance contained in ER 1105-2-100. Therefore, design and operation of separate trails for bicycles and pedestrian users is not allowed without being cost-shared as a betterment of the project. The coordination of trail use and associated betterment will be further coordinated with the non-Federal sponsors in future detailed design phases.



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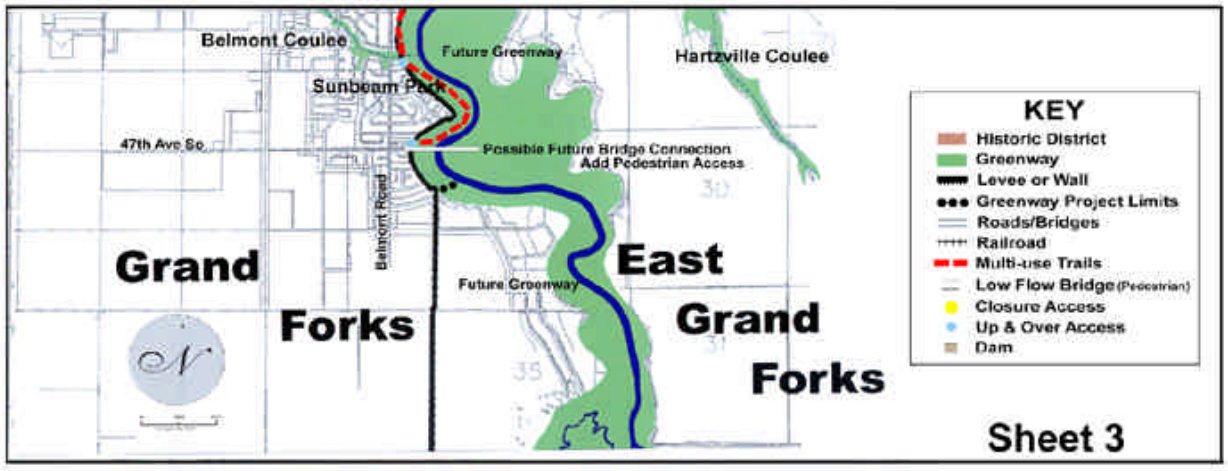

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Trails will be placed along the linear levee alignment on the west side of the Red River to provide a connecting trail from Riverside Park south to the Sunbeam area in Grand Forks. Approximately 14 miles of paved bicycling and walking/jogging trails will be built. In East Grand Forks the trails will encompass the city in a surrounding greenbelt with a low flow bridge across the Red Lake River to connect both levee systems. Approximately 14 miles of paved trails and 10 miles of unpaved trails will be provided in East Grand Forks. Along the trails there will be overlooks, and rest stops. Trailheads will provide access to the levee trails and to the Greenway and will include support facilities such as parking areas, toilets, shelters, benches, signs, lighting, interpretive material, and trash receptacles. Picnic areas will have shelters, tables, grills, and trash receptacles at several parks and access to Greenway locations along the flood reduction project.

A boat launch located in River Edge Park in East Grand Forks will be relocated to the Sherlock Park area. Two other boat launches are available, one at the north end of Grand Forks downstream of the dam and at Folson Park in East Grand Forks. An additional boat launch upstream of the dam, requested by Grand Forks, is to be located in the Central Park area. The North Dakota Game and Fish Department has provided guidelines for locating boat ramps and shoreline angler access along the Red River of the North.

The historic Burlington Northern Railroad Bridge that crosses the Red River is used as a recreation trail connection between Grand Forks and East Grand Forks. The bridge receives high use from bicyclists, joggers, and walkers who use the bridge on a daily basis. This bridge is scheduled to be removed in 1999 or 2000. To mitigate the functional impacts, pedestrians may use the sidewalk on both sides of the Demers Avenue Bridge. Other low flow bridge crossings will be available to cross the Red River between Riverside Park in Grand Forks and River Heights Park in East Grand Forks; Lincoln Park in Grand Forks and the Greenway in East Grand Forks; and to cross the Red Lake River near the Maplewood Addition to the Greenway access point off Highway #2 in East Grand Forks. See Appendix G, Recreation of the Supplemental Documentation Report for additional details about the recreation plan/features of the recommended plan.

BENEFITS AND COSTS OF RECREATION FEATURES

A detailed benefits and costs analysis was done for the recreation development proposed as part of the Federal multipurpose flood reduction project. The first cost of constructing the proposed recreation facilities is estimated to be $7,511,000 with an additional interest during construction cost of $1,612,000. The annualized cost of local operations and maintenance is estimated to be $337,000. These costs, when annualized result in an annualized recreation cost of $1,009,000. Recreation benefits associated with constructing the recommended plan were calculated to be $2,199,600 annually. Therefore, the benefits-to-costs ratio for the separable recreation features is 2.18. This shows strong economic feasibility. See Appendix D of Supplementary Documentation for additional recreation feature cost details and Appendices G of Supplementary Documentation for additional recreation benefits details.

Effects of the Recommended Plan

Based on Corps evaluations and public, interagency, and Local Sponsor inputs provided to this point in the plan formation and environmental evaluation process, it appears that the overall social, economic, and natural affects of the recommended plan would be positive. From the local perspective, the most important effect of implementation of the recommended plan would be that thousands of homes, businesses, and public structures would be reliably protected from future floods and removed from the 100-year floodplain. It is important to note that the economic analysis done as part of this study claims only national flood reduction associated benefits. The recommended project would provide many long-term local and regional economic benefits that are not incorporated into the economic benefits attributed to the recommended plan but are very real and important to the community and its residents. These include improved community cohesion, preserved and improved property values and local tax base, enhanced recreation opportunities, improved aesthetics, improved public health and safety, and future enhanced community growth and development opportunities.

There are areas of controversy that have been identified as part of the environmental impact statement scoping process. These areas of controversy include: 1) the need to take/relocate structures to implement the project, 2) the inability of the NED plan to include and protect some neighborhoods at the perimeter of the project alignments, 3) concerns about potential induced damages associated with implementing the plan, and 4) concerns about the adverse affects of the project on a number of historically significant structures. Most of these are short-term impacts associated with the unavoidable construction impacts of the project and the effects are limited to impacts on existing land users. These impacts include adverse effects to some existing historical structures and the unavoidable need to purchase and relocate a number of existing homes, apartments, condominiums, and businesses to allow for construction of the recommended levees and floodwall system.

An Environmental Impact Statement has been prepared to fully assess the impacts of the recommended project and obtain additional public and interagency comments. This document is a part of this General Reevaluation Report - main report.

Public and interagency inputs are being requested as part of the open comment period for the Environmental Impact Statement and further plan refinements will be conducted throughout the reevaluation phase. The refinements to the plan formulation that result from this ongoing coordination may alter project materials, design, cost, and cost apportionment or Federal participation in the project or any of its components.

Future Remedial Actions

Flood Reduction Measures Recommended

The recommended plan is not designed to protect against residual flood damages associated with very large floods. As a result, it is desirable – especially in an urban area like East Grand Forks/Grand Forks – to seek an additional increment of safety. This may be possible by pursuing basin-wide flood reduction solutions. These long-range flood reduction strategies are being coordinated through the International Coalition, the International Joint Commission, the Red River Basin Board, and other entities. The City Councils of East Grand Forks and Grand Forks have recognized the potential of these future studies. Other long-range strategies/measures that should be considered to further reduce the flood risk to Grand Forks and East Grand Forks include the following:

- Local, county, and township roads and future highways located in the Grand Forks and East Grand Forks areas should be designed as secondary lines of flood defense against potential future levee overtopping and/or failure. This is something that the local governments can control and implement. Over time, as Grand Forks and East Grand Forks continue to grow and replace or add to the existing infrastructure, this flood protection strategy should be planned for. The potential effectiveness of such measures can be seen in a related lesson of the 1997 flood. Specifically, in 1997, when the temporary levees gave way in East Grand Forks and Grand Forks, there was no way to protect most of the city from near total inundation. However, in Grand Forks, structures on the west side of Washington Street were able to be protected after the initial levee failure and overtopping. This was possible because Washington Street was constructed at an elevation that was high enough to allow it to be raised quickly and thereby allowed the road to act as a secondary/backup levee. This saved many structures from flooding.

- As new bridges are needed in the study area to serve a growing population and as existing bridges age, designing bridges so as not to obstruct river flows could provide an increment of flood risk reduction. This is a long-term strategy to be implemented after implementation of a Federal flood reduction project[3].

- Short-term flood reduction measures should also continue to be pursued. These plans are accomplished at the local level and will help to minimize the potential for short-term flood damages - prior to completing a permanent flood protection project. Existing emergency flood fighting plans should be kept up-to-date and national flood insurance should be purchased to help protect against flooding.

[3] Note that the only bridge that is incrementally justified for removal is the pedestrian swing bridge. But, from an engineering perspective, it is possible to reduce flood stage if the bridges are removed or elevated in such a way as to improve hydraulic efficiency. However, it is also important to note that simply raising a bridge may not improve the hydraulic efficiency.

Conclusions and Federal Recommended Plan

The 1997 flood demonstrated forcefully the need for a permanent flood protection project to protect East Grand Forks and Grand Forks. The temporary levee systems that currently have been built to provide flood protection do not meet Federal standards and do not provide a certifiable level of protection. Recent flood events along the Red River have caused the existing flood insurance mapping to become outdated. When revised Flood Insurance Study (FIS) maps are prepared for the Grand Forks and East Grand Forks area, almost the entire community will be located in the 100-year regulatory floodplain. This has many implications for the community and makes development of a permanent flood reduction project more compelling.

The recommended plan defined in this report consists of approximately 30 miles of permanent levees, floodwall, and road raises, which will ring both communities, and two small diversions to direct the flows in the English and Hartsville Coulees out of town during flood events. The permanent levees will provide a 210-year level of protection (0.47 percent exceedance frequency flood event) to both communities. This substantial and reliable flood protection for East Grand Forks and Grand Forks is important to implement from a local, State, and Federal perspective. The recommended plan also provides for implementation of recreation features that will become the foundation for future development of a locally managed greenway system. This multi-purpose recommended plan is feasible economically (i.e., detailed economic and cost evaluations result in significant net benefits and the plan has an overall benefits-to-costs ratio of 1.16).

Based on public, interagency, and Local Sponsor inputs provided to this point in the plan formulation and environmental evaluation process, it appears that the overall social, economic, and natural effects of the recommended plan would be positive. However, areas of controversy have been identified as part of the environmental impact statement scoping process. These areas of controversy include: 1) the need to take structures to implement the project; 2) the inability of the NED plan to include and protect some neighborhoods at the perimeter of the project alignments; 3) concerns about potential induced damages associated with implementing the plan; and 4) concerns about the adverse effects of the project on historically significant structures.

This draft report and EIS will be distributed to interested local, State, regional, and Federal agencies and to the public. After the 45-day public and interagency comment period on this draft report is over, review inputs received will be considered by the St. Paul District, Corps of Engineers and a recommendation will be formulated by the District Engineer. This recommendation will become a part of the final report that will be distributed for a formal 30-day public review in November 1998. Comments received on that final report will be analyzed and transmitted to the Chief of Engineers in Washington, D.C. for approval.

Further plan refinements will be conducted throughout the reevaluation phase. These refinements may alter project materials, design, cost, and cost apportionment or Federal participation in the project or any of its components.